ENGINEERING AND MINING JOURNAL

METAL AND NON-METALLIC MINING · MILLING · SMELTING · REFINING · MARKETING

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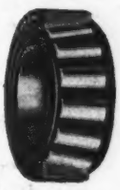
PROTECTION AT EVERY TURN IN MINING



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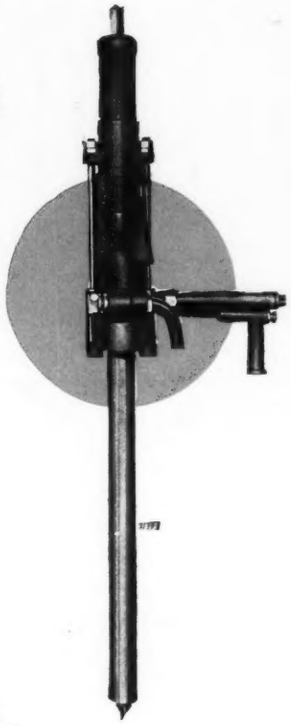

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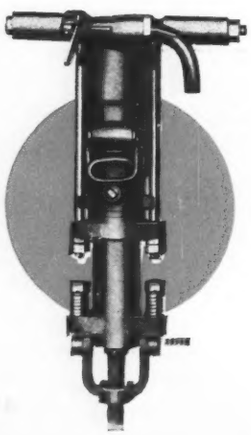

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ENGINEERING AND MINING JOURNAL

Number 21

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New York, May 25, 1929

Features of *E.&M.J.*: IX—Useful Operating Ideas

ALTHOUGH the prosperity of mining companies depends to a large extent on managerial policies and the efficiency of the processes used, the little things must not be disregarded. Efficiency in the various minor phases of technical operation is expected from the men in subordinate positions who have little opportunity to shape general policies. Of particular interest to them is that department of *E.&M.J.* devoted to Useful Operating Ideas. When a reader develops a way of solving a common difficulty he sends in a short description for this section. Even one such idea out of the 200 or so printed in a year may easily save hundreds of dollars.

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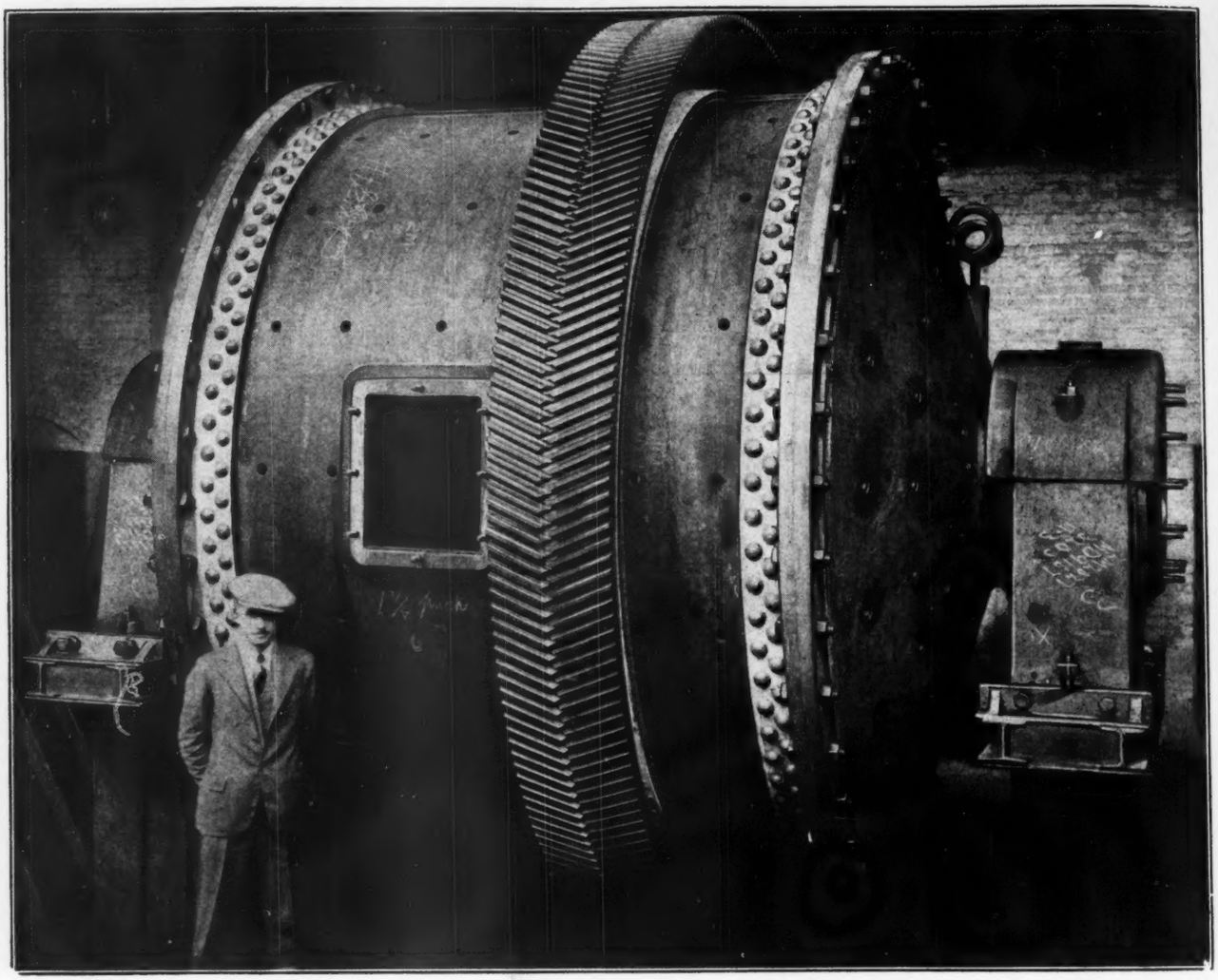
A Forward Step In Grinding



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A Better Understanding Is Fostered by Knowledge and Acquaintance

THE CHEMICAL ENGINEERS of the English-speaking world have learned the value of intercourse and reciprocity—social and intellectual. An example of this is seen in an imposing parchment received by the secretary of the American Institute of Chemical Engineers—Dr. H. C. Parmelee, formerly editor of *Chemical & Metallurgical Engineering* and now Editorial Director of the McGraw-Hill Publishing Company. The document reads as follows:

TO THE PRESIDENT, COUNCIL, AND
MEMBERS OF THE AMERICAN INSTITUTE OF
CHEMICAL ENGINEERS

GREETINGS

On behalf of the whole body of corporate and associate members of the Institution of Chemical Engineers and by the unanimous resolution of the Council at its first meeting of the present session, we, the President and Honorary Secretary, are directed to convey to you herewith the expression of our gratitude and appreciation for the hospitality and kindness which the members of our Institution received at the hands of your Institute during their recent visit to the United States and Canada at your invitation and as your guests.

The close co-operation and friendship which have from the first existed between our two societies have been immeasurably extended and strengthened by the interchange of visits which have now taken place between us. We look forward to a continuance of these happy relations to our mutual advantage.

The unrivalled opportunities which our members were afforded of seeing, in the course of less than three weeks, many of the chief centers and most famous sights of both the United States and Canada, and of inspecting in such exceptional circumstances and under expert guidance important centers of chemical and industrial manufacture and production in your country, and above all the association with the many acknowledged experts in the various branches of Chemical Engineering who from time to time acted as our hosts, have laid our individual members, our whole Institution, and the profession and industry of Chemical Engineering in this country under a debt of obligation to you.

We have no doubt whatever that the result of the tour of our Institution will be to widen the outlook of all those who took part in it and to confer material benefit on the many vital industries which were represented in our party, but we look to still greater and happier results. We are convinced that such visits will both assist and extend that cordial understanding between our peoples which is so essential not only to ourselves, but to the welfare of the world.

December, 1928.

[Sir] ALEXANDER GIBBS, President
J. W. HINCHLEY, Honorary Secretary

Before us is a letter complaining of the attitude of American mining engineers toward British mining engineers, indicting a body of professional men in one country of taunting their confrères in another country and claiming that the process might well be reversed. To some, it would seem, any action that hastens a scrap is justified. Taunts and jibes—odious comparisons—unfair distinctions! To what good? Merely to relieve the high blood pressure of an individual.

If the chemical engineers of the two greatest English-speaking nations can accept professional rivalries in a generous spirit, mingle in friendly intercourse, lose an inherited provincialism by travel, "hasten that cordial understanding between our peoples which is so essential, not only to ourselves, but to the welfare of the world," mining engineers can do the same.

The Treasure Hunt May Yield Unexpected Returns

LEGENDS of buried treasure and of mythical mines, apart from their romantic interest and their use in the fabrication of stories, arouse the incentive to explore unfrequented areas in a more minute way than is ordinarily done by the casual traveler. New information is obtained, and discoveries of scientific importance are sometimes made. A recent instance of this kind, recorded in the Los Angeles *Times*, states how Roscoe P. Conkling, of El Paso, was lured into southwestern New Mexico by old tales of buried Spanish gold reported to have been sequestered in a cave on Bishop's Cap.

A cave was discovered, on the slopes of the mountain peak; but, instead of decayed, iron-bound chests bursting with Spanish doubloons and guarded by mute skeletons, the excavations revealed sloth bones in close juxtaposition with human bones—a significant and interesting discovery that promises to advance paleontological research. Other caves in Western states have contributed to scientific knowledge. The history of man is of absorbing interest, but the evidence of his early life is exceptionally fragmentary. A good deal has been learned from cave deposits; much less from the evidence made available from recent strata. This new discovery promises to add a new chapter.

How many new mineral deposits have been discovered by prospectors lured by the legends of lost mines is not known, but many places have been explored as a result of such legends, and mineral deposits have been found that otherwise would have remained hidden for many years.

Ten Items of Excellent Advice

FOR MORAL GUIDANCE much of the world for many centuries has taken heed of the Ten Commandments. For business guidance it may well accept the philosophy of industrial success as recently propounded by Mr. Charles M. Schwab, chairman of the boards of the Bethlehem Steel Company and the Chicago Pneumatic Tool Company. He makes ten recommendations, which are as practicable in application as they are sound in principle:

Pay labor the highest possible wages. Prosperity is intimately related to a liberal wage scale. . . . Treat labor as a business partner. Successful industry depends more on human relations than upon the organization of money and machines. . . . Conduct business in the full light of day. Public confidence and public suspicion may be separated only by a door. . . . Remember that the law of supply and demand is inexorable. It would be also well to remember that there is no necessity for producing an excess. . . . Live and let live. Even prosperous industries cannot afford to have the backward industries too far behind the procession—prosperity to be permanent must be equably distributed. . . . Welcome new ideas. To establish permanent institutions we must always be prepared for change. . . . Never be satisfied that what has been achieved is sufficient. Smugness and complacency do not promote progress. . . . Operate business on the most economical basis. Price cutting, over-expansion, uneconomical methods of distribution are just as harmful to business and to the public as price fixing, monopolies, and rebates. . . . Look ahead and think ahead. It is easier to avoid depressions than it is to cure them. . . . Smile, be cheerful, and work upon the basis that the fundamental purpose of business is to promote the happiness of human beings.

Newmont Mining Absorbs Historic California Property

NEWMONT'S acquisition of the North Star and the Grass Valley property of Empire Mines marks the entrance of an important company into the gold-mining industry of California, which hitherto has not attracted the attention of the larger corporations. Gold mining in that state has lacked the leadership and the general confidence that result from the presence of large and influential operating companies. The industry has been maintained largely by the momentum acquired by past achievement; it has needed new blood. Increasing operating costs, adverse legislation, abnormal taxation, and high industrial compensation rates have hampered progress and played a part in discouraging new enterprise. Under such circumstances no ordinary mining properties would have excited the interest of Newmont Mining.

The Empire has an enviable record, dating from 1851. It has kept its stamps dropping while other mines have arisen, become famous, and have shut down. This has been the achievement of its manager, Mr. George W. Starr. Under his charge the necessary exploration and development work has been kept sufficiently in advance of stoping to insure steady production. The future of the property is considered to be promising. The Newmont decision to purchase is highly creditable to Mr. Starr and his technical staff.

The North Star also has had an almost continuous production record for three-quarters of a century.

India Will Eventually Remedy Mine Labor Conditions

A BULLETIN recently issued by the Geneva Bureau of the International Labor Organization of the League of Nations provides adequate reasons for the promulgation of a decree by the Indian government, providing for the gradual withdrawal of underground women workers from the mines of that country. Abstracts from the bulletin follow:

"According to official figures, the mining industry in British India employs 270,000 workers, of whom 87,000 men and 32,000 women are employed in underground workings. For several years past the government has been desirous of putting an end to the underground work of women. So long ago as 1922 a joint committee of the two houses of the Legislature recommended its abolition after a period of grace of five years. 'It is generally recognized,' the committee reported, 'that absolute prohibition of employment of women below ground in coal mines is a mere matter of time.'

"Under the regulations just promulgated, as from July 1 next, no woman may enter or remain in the underground workings of any mine other than an exempted mine, without the written authority of the Chief Inspector of Mines.

"For these mines (which in 1926 employed on a daily average 28,615 women below ground), failing the consent in writing of the Chief Inspector, the percentage of women who may be employed underground to the total number of persons employed is to be limited in accordance with a sliding scale which begins at 29 per cent for the coal mines and 40 per cent for the salt mines, and proceeds by a progressive annual reduction to complete abolition as from July 1, 1939, when the written authority of the Chief Inspector will be required for any departure from the prohibition.

"The underground employment of women will thus be curtailed at the rate of 10 per cent per annum. The industry will have ten years in which to adapt itself to the displacement of over one-fourth of its underground workers and one-ninth of its total labor force. And the declaration made not long ago in the International Labor Conference that 'India does not want to remain a backward country forever,' will be once more vindicated."

The Chief Inspector of Mines in India, giving evidence before the Simon Commission in December last, stated that the average pay for the male worker was equivalent to thirty cents per day; that of the women worker, sixteen cents. No discontent was in evidence, he claimed, the rates being higher than those paid by agriculture.

To defer a social reform until discontent is apparent, and until plans are being put into effect by agitators to capitalize on an undesirable situation, is dangerous. This period is usually the beginning of serious industrial unrest and economic chaos. India is wise to take steps to abolish a practice that to Western minds would seem to have no justification. Reform may move slowly there, but cause for satisfaction is seen in the determination of the government entirely to prohibit the employment of women in mines by 1939.

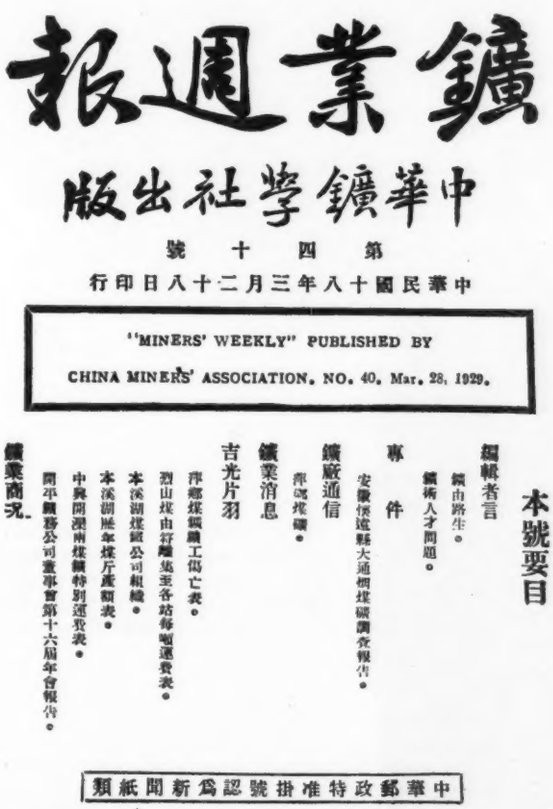
In the Interest of Conservation—And in Praise of Progress

THE amount of unsolicited "literature" that comes through the mail should result in an extremely liberal dividend policy by the manufacturers of waste-paper baskets. Editors are especially afflicted in this respect, for every publicity seeker is anxious to get his propaganda into journals of specialized circulation. To slide a morning's accumulation of second- and third-class matter, with a wide sweep of the arm, from the desk to a yawning receptacle at the side, is the easiest way; but the recovery of "values" by this method is obviously zero, even though the "tailing" is low-grade. So the patient editor usually gives at least a casual glance through the pile before him, hoping that he may find something of inspiration, or an item worth re-publication.

So long as the printed matter appears in English, at least an occasional spark of interest can be struck. Spanish, French, and more especially German publications are usually sufficiently different typographically to be worthy of a glance, and sometimes the title of an article will suggest the advisability of an attempt at translation. Russian and Finnish publications are not the total loss that one might at first guess, for often several pages of English can be found upon close inspection. But when a 26-page magazine in Chinese arrives regularly the editor is tempted to throw up his hands in despair. For the only characters intelligible to him are those shown in the reproduction of the cover page herewith. No address is given, so that the sender cannot be told that Chinese is like so much Greek to us—yes, even more so.

So this must be our only warning to the China Miners' Association: that receipt of their publication is a total loss so far as *Engineering and Mining Journal* is concerned. Their courtesy in sending us the publication is appreciated, and the Chinese stamps have added to the pleasure of at least one small boy; but until the editorial staff can boast a complete linguistic internationalism, the *Miners' Weekly* might well, in the interest of a proper regard for conservation of resources, be kept out of our already voluminous mail—with humble acknowledgment of our provincialism.

The Chinese and Japanese have been printing in the Western fashion for scarce fifty years, and in this art, as in many others, their progress has been without precedent. And though our limitations, with respect to their ancient and honorable language, the classic literary vehicle of both peoples, prevent a reading of the *Miners' Weekly*, we welcome it to the rather restricted professional family devoted to mining and its allied industries.



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礦廠通信 萍鄉煤礦。

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礦業商況

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The Shorter Working Day Foreshadows Increased Mechanization

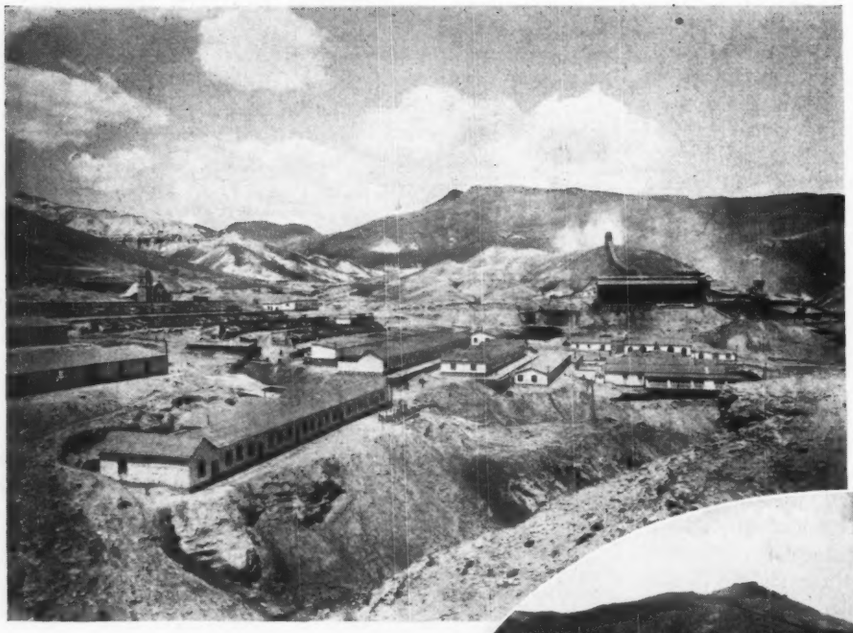
WITHIN the last two decades the working day in most of the industries of the United States has been reduced from ten or twelve hours to one of eight hours. Although the subject of severe criticism in the years preceding its general adoption, the shorter day is now commonly acknowledged to have aided materially in the economic development of the country. These facts lend support to the current expressions urging an even shorter day, or fewer working days per week, but the premise that a steady reduction in the hours of employment would hasten or insure increasing economic advantages does not, of course, follow. Nevertheless, a general desire prevails for more leisure—the direct outcome of the eight-hour day. The Saturday half holiday is almost universal, a seven-hour day is in force in most urban offices, and in some industries the five-day week is in effect. Widespread agitation for the five-day week and now, among railroad employees, for the six-hour day are steps in an important trend which must be given serious attention.

Inasmuch as a shortening of working hours is usually accompanied by the retention of the same daily wage as paid previously, the plan of further reducing the hours of industrial employment can be logically accomplished only by increasing the present productive capacity of the worker. This has already reached a high point in many industries, and how much more improvement can be achieved in this respect is questionable. Obviously, however, if the plan is to be introduced, the application of mechanical aids in industry must expand.

Mining, competing with other industries for its share of efficient workers, is concerned in the general problem; and, like the other industries, must look to increased production per worker as the principal means of meeting the situation when it arrives. Numerous opportunities, perhaps at the moment unrecognized, will be found to extend the present mechanization of the mineral industries as necessity develops. The foresighted executive, however, will be forearmed; he will have investigated every possible means of increasing the productive capacity of his employees. And on the results reached thereby will depend chiefly the practicability of adopting the shorter working day or week.

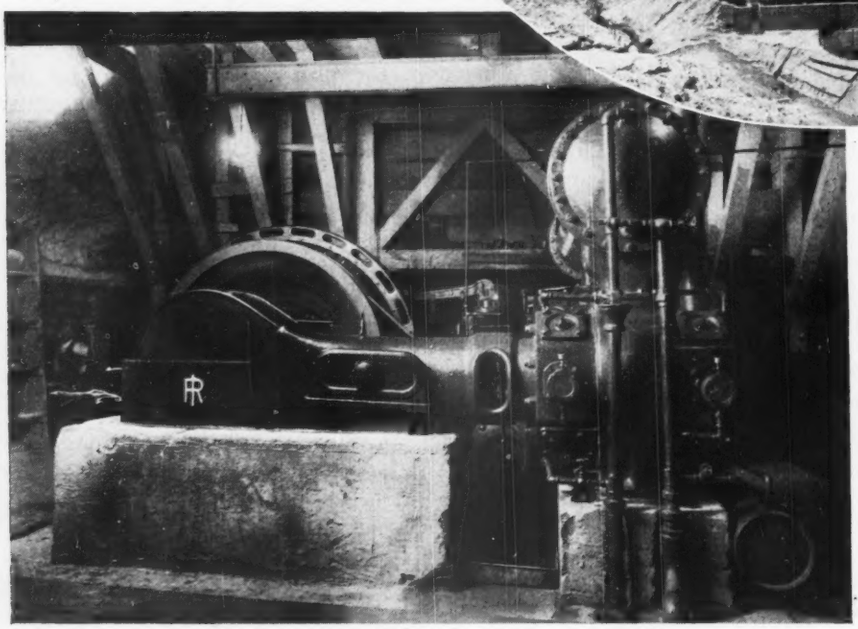
THE OPLOCA MINE . . . *An In*

SITUATED at an elevation of about 13,000 ft. and five miles from the railroad station of Chocaya, on the Tupisa branch of the Bolivian railways, in southern Bolivia, the Oploca mine, with its extensive operations, is one of the most important tin-producing properties in that country. Formerly the surface plant of the mine was



Above—Santa Ana; the concentrator and McDougall roaster plant are seen at the right

Right—Townsite at Santa Ana; main offices of the mine and the manager's residence are in the foreground



Left — Underground compressor installation at the Pacheco shaft, which was sunk to develop extensions of ore veins below the Oploca tunnel

An Important Bolivian Tin Producer

centered at Siete Suyos, but in recent years, since the extraction of most of the ore in the upper levels, Santa Ana has become the scene of the company's treatment operations. Here the ore, which averages 4 to 5 per cent tin and which contains considerable iron sulphide, is roasted and concentrated at the rate of 250 tons per day.

Above—Siete Suyos, where the operations at the mine were formerly centered. Main hospital on the property is seen at the left.

Left—Underground drill-sharpening plant at the Pacheo shaft

Right — The power installation at the Oploca mine is noteworthy. Main bay of the power house containing three 500-hp. Diesel engines is seen here.

Recovering Sulphur

From a Nevada Surface Deposit

By H. L. Hazen

Metallurgist, Humboldt Sulphur Company

RECOVERY of elemental sulphur from its "ores" has been carried on for centuries, but the methods used have been attended either by a low percentage recovery of the sulphur originally in the ore or by high costs per ton of sulphur marketed. Successive companies attempting to recover sulphur from the extensive deposits at Sulphur, Nev., spent several hundred thousand dollars in seeking a solution of their problem. To be successful some process was required that would give a high recovery and low costs, and by low costs is meant a cost that would yield a substantial profit when selling the recovered sulphur in the Western markets of the United States.

The Nevada sulphur deposits are favorably situated in that the main line of the Western Pacific Railroad passes along their northern boundary. In addition, although in the Black Rock desert, plenty of water for camp purposes is obtained by gravity flow from springs about 4 miles distant. Following unsatisfactory results in treating the deposits by the steam retort and Crowley processes, and after considering the possibilities of numerous other treatment methods, including liquation, sublimation, lixiviation, and the Frasch and Baum processes, the coalescing method was investigated.

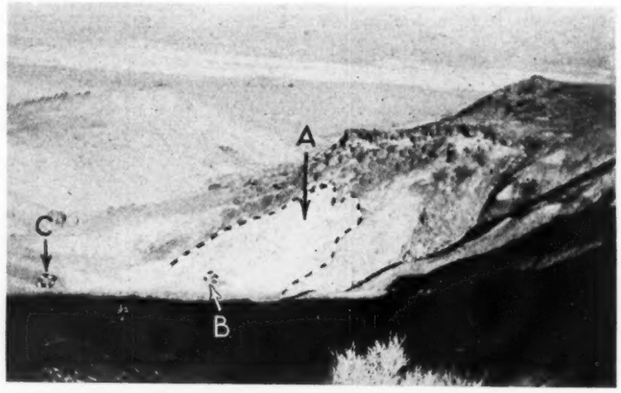
Investigation of the Coalescing Method

In applying the coalescing method the sulphur ore was first ground to pass a certain screen size, such as 10-mesh or finer. The ore was then pulped with water to about a 1 to 1 mixture, sealed into a pipe smaller than 6 in. in diameter, which was rotated and heated while rotating to about 260 deg. F., and then allowed to cool while rotating. After cooling, the contents of the pipe were washed on a screen. Most of the sulphur collected and solidified into a few lumps much larger than the screen openings, which permitted all the gangue to pass through. On an average, the large lumps contained 97 per cent sulphur and the tailing passing through the screen assayed about 3.5 per cent sulphur. The grade of ore tested contained 23 per cent sulphur, indicating a recovery of about 87 per cent of the sulphur originally present.

The concentrates, or lumps, were a mixture of coarse gangue imbedded in lumps of substantially pure sulphur. Simple liquation of this concentrate would result in a separation of pure liquid sulphur from the gangue, which would settle to the bottom of the liquation tank. It was readily seen that this method might prove most attractive and profitable, and I therefore spent several weeks thoroughly testing its possibilities.

Investigation showed that coalescing of the sulphur would not occur if the pipe container were larger than 8 in. in diameter, and it is doubtful whether results with a pipe larger than 6 in. in diameter would be satisfactory. Using larger diameter pipes, solidified sulphur would still be free and separate from the gangue, but it would be in the form of tiny pellets, most of them smaller than the sand in the gangue. Observations made in the course of the investigation were:

1. The sulphur particles, whether large lumps or tiny pellets, were always composed of pure sulphur. The gangue particles did not have any sulphur adhering to them.



Devil's Corral deposit of Humboldt Sulphur Company, Sulphur, Nev.

"A," Largest single outcrop of sulphur ore on the property; this averages 26 per cent sulphur. "B," Portal of adit driven 62 ft. into the deposit; the face at the end of the adit assays 44 per cent sulphur. "C," Collar of shaft situated 103 ft. from the portal of the adit.

2. When the pipe was smaller than 6 in. in diameter the sulphur solidified in large lumps.

3. When the pipe was larger in diameter than 8 in. the sulphur solidified in tiny pellets.

These observations are explained as follows:

(a) Liquid sulphur does not "wet" silica in the presence of superheated water—that is, superheated water will push liquid sulphur off the surface of silica.

(b) Although silica has a specific gravity of about 2.5 as compared to 1.8 for liquid sulphur, if the net weight of the settled particles of gangue resting on the surface of the liquid sulphur is not sufficient to overcome the surface tension, the gangue will float on the surface of the liquid sulphur.

(c) If the net weight of the accumulated gangue settled on the surface of the liquid sulphur is sufficient to overcome the surface tension, then the gangue particles

will be forced into the liquid sulphur. On continued rotation the liquid sulphur is divided into small drops by grinding action of the gangue.

Refining Sulphur Flotation Concentrates[1]

If the foregoing reasoning was correct, it followed that the pool of sulphur would not be disturbed if the gangue could be kept in suspension in the water above the liquid sulphur. This could be accomplished by agitating the pulp of gangue and water. In the natural course of agitation many of the gangue particles would impinge on the surface of the liquid sulphur, but it was probable that they would be successfully resisted by the surface tension of the sulphur. The easiest method of agitating and at the same time heating the charge was to bubble steam up through the charge from the bottom. This was tried and proved successful.

In actual practice two refining retorts were used, but later a larger retort was built having a production capacity of 35 tons of pure sulphur per 24 hours from a flotation concentrate analyzing 77 per cent sulphur. Continuous operation of this method has not yet been worked out, although there appears to be no reason why it should be particularly difficult to do so. To date about 2,700 tons of sulphur has been produced by this method, the batch system being employed, the successive steps of which follow: (1) The refiner is filled with filtered flotation concentrate which contains about 18 per cent moisture. (2) The blow-off valve near the top of the refiner is closed, and the Kelley head lowered into place and tightened. (3) Steam is turned in at the bottom. (4) Liquid sulphur is drawn off through specially constructed valves. (5) Blow-off valve at top is opened and pressure released. (6) Kelley head is released and the retort dumped and washed out. On an average this cycle will produce five tons of pure sulphur. About seven cycles can be made per 24 hours.

The aforesaid simple procedure was developed from a rather complicated and troublesome arrangement used at first. The different steps were gradually simplified by the men operating the refiner, and I am especially indebted to George B. Moore and M. G. Haigh for successful results. The sulphur produced is quite pure. The lowest grade carload sold averaged 99.6 per cent sulphur and the highest grade carload 99.85 per cent. The sulphur commands a premium in the market because it contains not even a trace of oil. Absence of oil in the final product is, however, a virtue of the deposit and not of the process. It is interesting to note that flotation reagents do not interfere in the final product.

Only two difficulties have been encountered in refining the flotation concentrate. These are: Failure of sulphur to coalesce into a pool, and accumulation of gangue around the sulphur draw-off pipe. When the sulphur fails to coalesce, the molten sulphur remains in small drops inextricably mixed with the gangue particles, but each drop of sulphur is free of gangue and in itself substantially pure sulphur. It was found that this was caused by a film of ferrous sulphide around each liquid sulphur drop, which acted as a barrier, preventing the liquid sulphur in one drop from contacting with liquid sulphur in an adjacent drop. With the particular ore used, the mill circuit became quite acid, dissolving iron worn off the grinding balls and also from other equipment; this iron then partially precipitated on the sulphur. The trouble was overcome by controlling the maximum amount of iron in solution, but, of course, another method of procedure would have been to use equipment that presented no iron surface to the mill pulp. This would have necessitated the use of silex-lined pebble mills, rubber-lined pumps and pipes, and like equipment. I had always thought that a strongly alkaline mill circuit would solve the problem, because no iron could ever enter solution and so could not precipitate on to the sulphur. Every attempt made in that direction, however, has so far met with failure, and a flotation concentrate obtained from a strongly alkaline pulp has been almost impossible to refine. Accumulation of gangue particles around the sulphur draw-off pipe occurred when the gangue was too coarse or the steam manifold became clogged. In practice the ore was ground to pass 48 mesh, and the steam manifold was cleaned once a week whether it needed it or not.

Tailing dumped out of the refiner each cycle averages about 35 per cent sulphur and is returned to the flotation circuit, where the sulphur is extracted again. The sulphur in the tailing is in the form of small beads, each of pure sulphur and free from gangue. Evidently these beads are drops of sulphur that were kept in the pulp above the sulphur pool by the severity of the agitation. It is hoped that means will be found for reducing this tailing assay. Capacity of the refiner per cycle is affected greatly by the grade of the flotation concentrate, as shown by the following tabulation:

Grade of Flotation Concentrate, Per Cent Sulphur	Per Cent of Sulphur in Each Charge
50	46.01
60	64.10
70	76.77
80	86.53
85	90.47

The flotation plant of the Humboldt Sulphur Company conforms to modern mill practice so far as possible in a mill that was built for some other process. Two noticeable errors in construction are: (1) The location of the plant is such that it cannot be expanded, the equipment being crowded together; and (2) the mine ore enters at the bottom of the mill and the flotation tailing leaves at the top. The ore is crushed in gyratory and roll crushers to about ¾ in., then ground to 48 mesh in a Hardinge ball mill operating in closed circuit with a Dorr classifier. The ground pulp is elevated by a Wilfley sand pump to Kraut flotation machines, the concentrate from which is cleaned and re-cleaned in Forrester type flotation machines. Sand is removed from the flotation tailing by a Dorr classifier and sent to waste. Slime in the tailing is thickened in Dorr tanks and as much water as possible is recovered. The flotation concentrate is thickened in a Dorr tank and then dewatered by an Oliver filter.

Many flotation reagents have been tried, but the best results have been obtained with Aërofloat No. 15; about 0.05 lb. of this reagent alone are used per ton of ore. Recovery has averaged about 85 per cent of the sulphur originally in the ore. The concentrate has averaged 77 per cent sulphur, and mill heads, which were made up of half mine and half dump ore, about 15 per cent sulphur.

[1]The Hazen process; patent applied for.

DRIVING the CLAREMONT TUNNEL

A BORE in MEDIUM GROUND

By GEORGE J. YOUNG
Associate Editor

THE Claremont tunnel of the East Bay Municipal Utility District, Oakland, Calif., is an example of tunnel driving in medium ground, as contrasted with "hard rock." It is timbered with five-piece arch sets throughout. Apart from the interest that it has in respect to the nature of the ground, two other conditions surrounding the work are also worthy of mention. One was the occurrence of strata gas, methane, at several points, and the other the relatively large water flows encountered. Some soft ground was also cut. The tunnel is 18,004 ft. in length, with a fall of 12.89 ft. from the east to the west portal. This low grade made the water especially troublesome. Water flows were inconsequential at first, but reached a maximum of 4,000 g.p.m. in November, 1927, declining to 1,690 g.p.m. by Jan. 30, 1929. The total flow between November, 1927, and January, 1929, was 2,056.31 acre-feet. Cemented gravel, shale, and chert, sandstone and volcanics, comprised the formations penetrated, the series being almost wholly in the Tertiary formation.

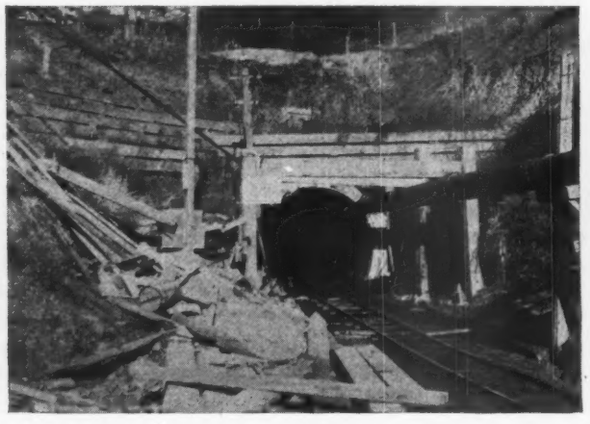
The west portal is on the Berkeley side close to the Oakland-Berkeley boundary line in the near vicinity of the Sacramento Short Line Railroad, and the east portal is at Orinda. The range of hills penetrated reaches an altitude of close to 1,700 ft., the maximum height of rock being 1,325 ft.; the elevation of the west portal is 328.12 and that of the east portal, 341.05 ft. A geological section was prepared. Knowledge of the fact that considerable water was to be anticipated proved advantageous, particularly in constructing the invert before water flows were encountered. The section of the tunnel in the rough was about 12x12 ft. The finished section (concreted) corresponds to a 9-ft. horseshoe with an invert of 9-ft. inside radius. Material excavated averaged 5.5 cu.yd. per foot, the neat excavation being 4.6 per foot. Overbreak averaged about 30 per cent. A concrete lining from 4 to 6 in. over timbers and a concrete invert will complete the tunnel. A 1:2:4 concrete mixture was used on the reinforced section and a $1:2\frac{1}{2}:5$ mixture on unreinforced sections. The estimated cost of the tunnel is $1,752,928, about $97.30 per foot, or about 65c. per cubic foot of average excavation.

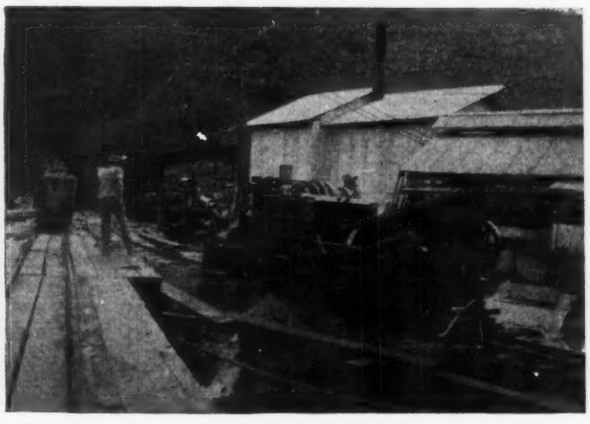
Rapid Progress Made

No attempt was made to achieve a record. Excavation began at the west portal in July, 1926, and at the same time a two-compartment shaft, 77 ft. in depth, was sunk at the east portal to the tunnel line. Tunnel work started from two faces at the shaft, one northerly to a connection with the Lafayette tunnel and the other southerly toward the west portal. A total of 6,614 ft. was driven from the east and 11,390 ft. from the west portal. Holing through took place on Jan. 19, 1929, or 31 months from date of beginning. At this time the work completed included 8,458 ft. of concrete arch and 7,330 ft. of additional invert, leaving 2,350 ft. of invert and 9,680 ft. of concrete arch to be done to complete the job.

Sequence of operations was as follows: First, excava-

Left, West portal of tunnel, showing finished section and ventilating pipe. Right, Conway mucking machines were used on both sections.





Left, Storage-battery locomotives and side-dump cars were used in transportation. Right, steel forms used for arch construction, also for transfer car used for moving forms.

tion and timbering, which was interrupted from time to time to construct the concrete invert; second, the placing of forms and the pouring of the concrete arch. Timbers were left in place, and no work was required upon them except to cut the necessary clearances where timber overlapped the concrete section. Both invert work and arch construction were placed in sections, a section being started at the point furthest from the portal and the placement being made successively back toward the portal. Invert construction was preceded by the placing of stretcher timbers across the lower part of the section and the transfer of the track to this elevated position, after which the invert section was cleared, the reinforcement placed, and the concrete followed. In placing the invert the section was kept drained by centrifugal pumps operated by compressed air. Necessarily the three major operations—excavation, invert construction, and arch construction, were sequential—and as a consequence during invert construction excavation was temporarily suspended.

At the west portal the maximum excavation footage in one month was 856 linear feet. Over 500 ft. per month was made in nine months, not necessarily successive. At the east portal 722 linear feet of excavation was the maximum in one month. In placing the invert on the west portal the maximum footage in one months was 3,149; on the east portal, 2,726 ft. The maximum monthly rate of arch construction on the west portal was 905 ft. and on the east portal 1,820 ft. Averages are not especially significant, but they work out as follows: West portal, average excavation for 25 months, 408 linear feet; invert, 2,242 ft. for four months; and the concrete arch 805 ft. for two months. East portal average excavation for 11 months was 569 ft.; invert, 1,029 ft. for six months and 882 ft. of concrete arch for seven months.

Flood Followed by Gas Flow

Several interruptions occurred in each section. At the east portal a flood in the Lafayette tunnel affected the east portal workings and required three months' work to recover the tunnel and remedy the damage. On the west portal workings a gas explosion on June 23, 1927, temporarily delayed the work. A heavy gas flow succeeded a run of rock from a fissure and became ignited in some unknown manner, the gas flame spiraling around and traveling a short distance away from the face, where a mild explosion followed. An ample ventilating current no doubt minimized its effect. The workers at the face suffered burns. At the east portal blasting ignited carbonaceous and apparently oil-soaked rock and a persistent fire resulted. This was finally controlled by the erection of a bulkhead and the use of 40,000 cu.ft. of carbon dioxide gas. Another fire of less importance interfered with operations in the east end. In subsequent excavation small quantities of gas were encountered, but no major difficulties ensued. Only small sections of swelling ground were encountered.

Geological Section Used to Check Class Work

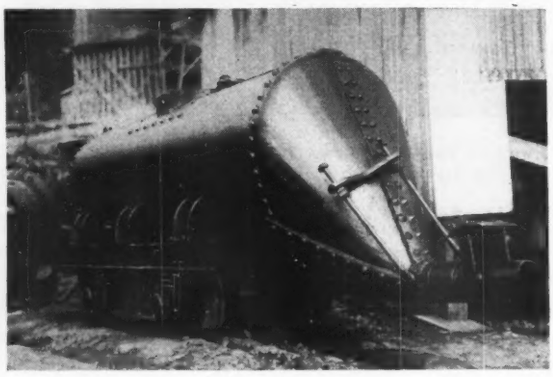
The tunnel is electrically lighted and flashlights are used for supplementary lighting. Greater care was taken to test gas flows, safety lamps being used for this purpose. Some petroleum was also encountered, but the quantity was incidental and not indicative of anything of importance. No "mineral" was encountered, although close to the west portal outcrops occur of Lawson's "siliceous carbonate sinter," an accessory of quicksilver deposits. Incidentally, the geologic section afforded by the tunnel is being used by Dr. G. D. Louderback to check the areal geology which has been intensively mapped by geology and mining students of the University of California.

Leyner drills (No. 7 Denver Rock Drill and No. 70 Ingersoll-Rand mounted on 10-ft. 6-in. crossbar) were used on hard faces, but the greater part of the drilling was done with hand-held drills (I-R BCR 40), standard cross bits being used in firm ground and auger steel and fishtail bits in the softer shale. Depth of rounds varied with the ground and was gaged by the timber interval, collar braces being prepared in 4-, 5- and 6-ft. lengths. Tunnel sets were five-piece with 6-ft. posts. Timber cross-section was 8x8 in., but was later changed to 8x12 in. About 400 bd.ft. were required per tunnel foot. Drilling and blasting time averaged two and one-half hours and mucking with the Conway machine three hours. After drilling and blasting, the top lagging boards were driven forward to give top protection, and mucking was started. After clearing out the face the timber set was erected and blocked in place, side lagging being placed where necessary. The advance per shift was from 4 to 8 ft. and 24 ft. advance was often made in a day. The maximum daily advance was 33 ft. An average of 24 ft. advance was made for three months.

Explosive to the average amount of 20 lb. per foot was used, 25 to 30 per cent gelatine and electric exploders. The average number of holes per round was 18, but sometimes 30 and at other times as few as

12 were required. Transportation was the variable item. An hour was required to bring out trains during the last stages when the water was troublesome. Before this, twenty minutes was required for an out trip. Water increased the time element and also the transportation costs about 200 per cent. Most of the water was encountered in the igneous rocks over a length of from 400 to 600 ft.

For draining the invert section a special rig was devised and proved satisfactory. Two self-contained units, each



Hackley cement gun used in arch concreting.

consisting of a 3-in. centrifugal pump direct-connected to a flexible coupling and an Ingersoll-Rand Little David compressed-air engine, were used in this service. The unit is transportable and can be placed out of the way. Ventilation was provided by a 15-in. riveted and tarred pipe suspended on one side of the section. Slip joints were used, and for the most part air was forced into the pipe. Suction service was not satisfactory. A No. 5½ Root blower driven by a 100-hp. motor was placed close to the portal and supplied about 4,000 cu.ft. per minute for the service. A 4-in. compressed-air pipe and a 2-in. water main were placed on the side of the tunnel opposite to the ventilating pipe.

During excavation sidings were placed at 1,500-ft. intervals, and later these were left at about ¾-mile intervals. Track was 2-ft. gage, 30-lb. rail. Koppel side-dump car, having a 50-cu.ft. box body and roller bearings, were used on both headings. Six storage-battery locomotives, two of them General Electric and four Westinghouse, were used in transportation service. All were rated at about 2,000 lb. draw-bar pull and 3.5 m.p.h. speed. They rendered excellent service under the severe water conditions. Brushes, field coils, commutators, and insulation gave trouble. Difficulty in securing spare parts promptly was experienced.

A 10-ft. steel form in three hinged sections (top and two sides) was (and is) used in concreting. Side plates were ¼ in. in thickness, reinforced by five angles. Bolts and sometimes through rods were used to joint the sections. A transfer car was employed for moving the sections. A Hackley compressed-air gun, 2-cu.yd. capacity, is used in placing the concrete, a 60-ft. 6-in. steel pipe flattened down to 4 in. being required to deliver the concrete at the top of the arch between the timbers and the steel form. For concreting the invert, concrete was handled in the side-dump cars, but for the arch it is necessary to haul the gun to the mixing plant outside for each fresh charge. Here the distance becomes a troublesome factor.

At each portal a substantial plant was erected, these structures being duplicates save for a few features. The compressor plant at the west portal contained two I-R Imperial compressors, each driven by a 150-hp. motor, and a smaller compressor of the same type driven by a 100-hp. motor. The east portal plant was equipped with two compressors only. All were operated by short-center belt drives. Two 15-kw. motor-generator sets with a two-panel board served for charging the storage-battery locomotives. A drill-sharpening shop equipped with a No. 5 Ingersoll-Rand sharpening machine and forges; a timber saw; a concrete mixing machine with accessory bunkers; and offices, bunk houses, and commissary completed the equipment. Conway mucking machines were used at both ends of the tunnel. At the east portal a double-drum motor-driven hoist and cages were used in the shaft service.

Marston Campbell is the resident engineer in charge of the tunnel and L. M. Larson is foreman for the contractors, Grier & Mead. The working force at each end totaled from 45 to 55 men.

Chinese Mining Laws to Be Revised

IN THE series of circulars being published by the U. S. Bureau of Mines on the mining laws of foreign countries, Circular 6,111, "Mining Laws of China," has recently appeared. This was written by John W. Frey. The most important points in the present mining regulations are as follows:

1. Recognition of mining rights apart from the ownership of surface rights.

2. Adoption of the claim system granting rights of priority on application with the proper maps and descriptions.

3. A mining tax of 1½ per cent on the precious metals and coal.

4. The limitation of foreign capital, which must not exceed 50 per cent.

5. Foreigners must be represented by Chinese in dealing with the authorities.

6. Mining rights may be forfeited for any one of six reasons: cessation of work for a year; injury to public interests; non-compliance with police regulations; mistaken sanction to operations; failure to work in accordance with approved plans; or non-payment of taxes.

The new laws of the republic may be more favorable to foreigners. According to Dr. Wong Wen-hao, Director of the Geological Survey of China, a commission has been appointed by the president of the Nationalist government at Nankin for the purpose of drafting new mining laws and regulations.

Magnetite Property, Operated in 1756, Still an Active Producer

ONE of the oldest productive properties in the United States is the Forest of Dean mine, near Fort Montgomery, N. Y., which has been a source of high-grade magnetite since 1756. Besides historical background, the property is noteworthy for the unusual character of the ore deposit and for the mining methods employed. A description of the mine by H. D. Keiser, assistant editor, will appear in an early issue.

Strontium Deposit Discovered in Arizona

ALTHOUGH nearly 5,000 tons of domestic strontium rock, chiefly the sulphate of strontium, was mined in California, Arizona, and a few other states in 1916 to 1918, when imports were practically cut off, the domestic product could not compete with imports when foreign trade became re-established after the World War. Imports from 1923 to 1927 have been as follows:

Imports of Strontium Chemicals and Ore Imported for Consumption, 1923-1927 (a)

Year	Pounds	Value
1923	5,281,818	$131,420
1924	3,993,226	59,937
1925	4,826,612	162,533
1926	5,433,044	115,436
1927	4,233,816	149,383

(a) Compiled by J. A. Dorsey from records of the Bureau of Foreign and Domestic Commerce: "Mineral Resources of U. S., 1927."

Because of these conditions, a recent discovery of a strontium deposit by Milton Ray, of Aguila, Ariz., was of more than passing interest, and B. S. Butler, of the U. S. Geological Survey, was requested to examine the deposit and supply the government with first-hand information regarding it.

The deposit is about 15 miles southeast of Aguila, on the Santa Fe Railway. It is reached from Aguila by a road leading over the flat intermountain plain for 10 miles and then into the east end of the Vulture Range or Black Butte. In the mountains the grades are moderate, and the road, though rough, can easily be put into good condition. The strontium deposit crops out for about 1,100 ft. along the strike of the formation and probably 1,300 ft. or more as exposed in the semi-elliptical outcrop along the cliff. The strontium-bearing beds are of varying thickness and alternate with tuffaceous beds. What is apparently the most persistent bed of strontium rock has a thickness of 12 to 20 ft., through which the larger part of the material is massive celestite in beds 6 in. to 6 ft. thick, separated by thin layers of tuffaceous material containing considerable strontium. Except in the cliff the beds are largely covered by a rather thin veneer of the basaltic fragments from the flows above, and as trenches have not yet been opened completely across the strike, it is not possible to say how many beds of strontium rock are present or to state the thickness except as given for the cliff outcrop. In the central portion of the strontium area, however, strontium extends for 400 ft. across the strike and must be present through a stratigraphic thickness of 150 ft. or more. The beds of strontium rock have the general appearance of being interbedded with the volcanic series, but a study of the thinner beds, especially, leaves little doubt that the celestite is the result of replacement of the tuffaceous material. Some beds have been almost completely replaced by massive celestite; others only partly. In some beds the texture of the tuffaceous beds is still apparent in the celestite.

Strontium rock is present in the float along the general strike of the formation for 2 miles or more, but only at the locality mentioned does it seem to occur in large amounts. Celestite is the main strontium mineral. An analysis by J. G. Fairchild of what was selected as a good specimen from one of the massive beds gave the following composition:

	Per Cent		Per Cen
SrO	48.10	BaO	Not found
SiO_2	12.91	CO_2	0.57
Fe_2O_3	0.39	Al_2O_3	Not found
MgO	Not found	SO_3	36.70
CaO	0.41		

This analysis shows 85 per cent of strontium calculated as the sulphate, celestite, and the total would be somewhat under 100 per cent. Manufacturers in the United States used rock containing 85 per cent of strontium sulphate in 1918, but they preferred material with at least 92 per cent. A sample taken from 64 in. of massive strontium in five beds from 7 to 20 in. thick distributed through 8 ft. of rock, the remainder of which was unreplaced or partly replaced tuff, was analyzed with the following result:

	Per Cent		Per Cent
SrO	41.26	CaO	0.29
SiO_2	22.10	BaO	0.33

This analysis shows about 73 per cent of celestite, and the sum would be under 100 per cent. Microscopic examination of the material from the outcrop shows the presence of strontianite, the carbonate of strontium, replacing celestite. In the vicinity of the deposit the basaltic boulders are cemented by a caliche-like material, largely strontianite, that has doubtless been derived from the celestite deposit.

Developments, Amount, and Availability

The developments on the different claims consist of open cuts in the outcrop of the beds. These open cuts and the natural outcrops indicate that the strontium beds are continuous for several hundred feet along the strike. As there has been no development at depth down the dip of the beds, the conditions in that direction cannot be stated positively, but there seems no reason to suppose that the deposits will not continue for a considerable distance underground.

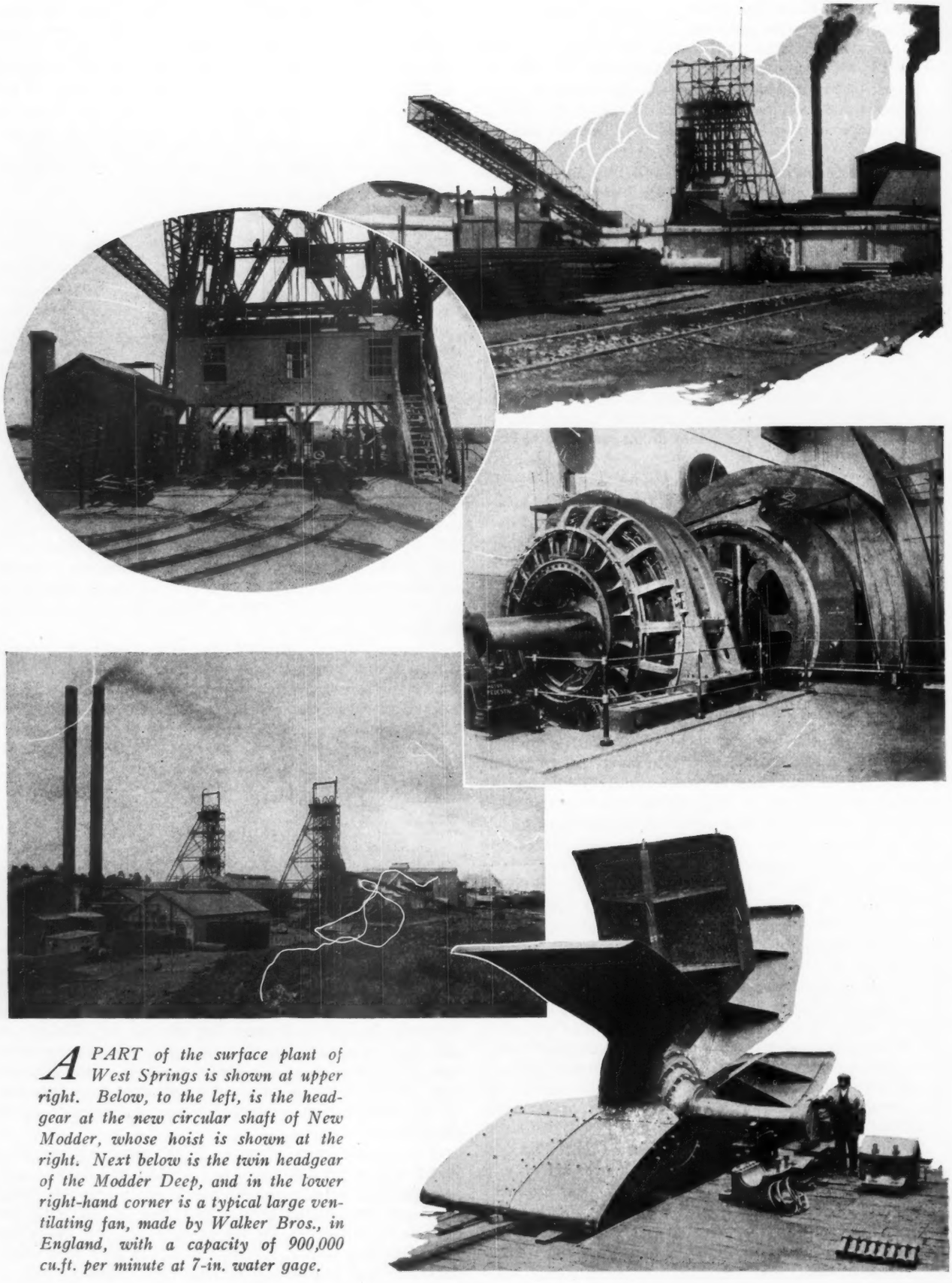
The information available is too meager to warrant a positive statement of the amount of strontium-bearing material present in this deposit. The beds have been opened in numerous places, and mining of the material could be started by open-cut methods as soon as a market is available.

High Price of Cadmium May Retard Its Use

THE employment of cadmium has increased rapidly in the last few years, and with good reason, as this type of rust protection has a big field and fills its place very satisfactorily, says Otto H. Loven, in an article on cadmium plating in *The Metal Industry*. Its usefulness would be increased many fold if it were practical to use it as a sub-coating under nickel and chromium, and still achieve the same high finished surface as is now obtained through the use of copper, but the use of cadmium in the above mentioned combination has not been worked out satisfactorily on a commercial scale, although this may still be accomplished and would then constitute one of the most important advancements in the art of metal finishing.

The recent sharp advances in the price of cadmium metal, however, have tended to retard the use thereof, and other finishes have been substituted. At present the price is 75 per cent higher than a year ago, and if the price advances still further, the use of cadmium will surely die out, according to Mr. Loven, and be replaced with other finishes which can be applied more economically.

Progress in the Rand



A PART of the surface plant of West Springs is shown at upper right. Below, to the left, is the headgear at the new circular shaft of New Modder, whose hoist is shown at the right. Next below is the twin headgear of the Modder Deep, and in the lower right-hand corner is a typical large ventilating fan, made by Walker Bros., in England, with a capacity of 900,000 cu.ft. per minute at 7-in. water gage.

Gold-Mining Industry

The Question of Untapped and Unpayable Deposits

By Arthur G. Boyden
Johannesburg

ONE OFTEN WONDERS when the peak of production will be reached on the Rand and a gradual decline set in, owing to higher working costs and lower grade of ore. Last year the output of gold for the whole of the Union of South Africa amounted to 10,354,264 oz., valued at £43,982,119, which easily constitutes a record for these fields and the bulk of which is to be credited to the mines of the Rand; but all indications point to nothing like this happening again during the lifetime of any one at present on earth. A recent estimate of the life of the gold-mining industry here is put down by a local authority at 200 years. This is based on the assumption that great economies will be effected through cheaper and higher extraction, cheaper methods of hanging-wall support, better ventilation, leading to increased efficiency of labor, and cheaper explosives.

An enormous tonnage of 3½-dwt. rock and lower still remains in the mines, largely developed, but economically worthless under present mining conditions; yet it requires only a further small reduction in working costs to bring this reserve into the category of commercial ore, thereby doubling the lives of many current producers. Such revolutionary economies have been effected during the last decade, notably in methods of breaking ground, resulting in bringing down the former pay-limit of 6.5 dwt. to 4.0 dwt., that optimism concerning the unpayable reserves would seem to be justified.

Another reason for thinking that the figure mentioned conservatively indicates the probable life of these gold fields is that, so far, only a portion of the great basin or syncline in which the gold-bearing beds of the Main Reef series fall has been worked during the last 40 years. In fact, the Rand forms much the smaller portion of the basin, the major portion, as here and there revealed by outcrops before the conglomerate beds dip under newer formation like the Gatzrand, having been traced to Potchefstroom, which is about 80 miles southeast of Randfontein—the present western limit of the industry's activities. From Potchefstroom the reefs continue to Klerksdorp and then cross the Vaal River into the Orange Free State, where their outcrops can be seen 20 miles south of the river. After running south, they bend eastward along the rim of the basin, and after continuing for many miles within the Free State, they again cross the Vaal and re-enter the Transvaal, still bending their course conformably with the oval of the basin. They then run north to join with the Springs deposits, which represent the present eastern limit of the Rand's mining operations. Though little or nothing is at present known about the gold content at depth in these unprospected regions of the reef deposits, only a very small slice has so far been taken out of the "banket pie" lying so temptingly in its oval basin with a hard, thick, troublesome crust of quartzite on top of it.

The Rand's gold mines are, in the Central area especially, getting deeper and deeper, and there is no saying at present when or where the economic limit of depth will be reached. Already the west sub-incline shaft of the Village Deep is fast approaching its final depth of 7,640 ft. (1.4 mile) below the collar of the new Turf Shaft. The mean depth of stoping levels at the end of 1928 was 6,480 ft. below shaft collar and the maximum depth of winzing below the 39th level was 7,360 ft. Depths are thus fast being approached which will give rise to serious problems having no parallel in other mining fields to help in their solution. One of these problems is how the enormous pressures are to be dealt with, which will probably mean the substitution of incline shafts for short verticals and crosscuts, shorter backs, and narrow stopes worked on the panel system. The danger from rock bursts, which, as it is, occur now and then and generally take their toll of life, will undoubtedly be increased and prove more formidable than the phthisis menace. This, though it has slain its thousands, has never yet closed down a mine, and thanks to the energetic and intensive policy of dust prevention in force, is now well in hand, the dust content of the mine air being only 0.8 mg., against 5 mg. per cubic meter in 1914.

Another important factor that may seriously handicap deep-level operations is the ventilation difficulty. The increment rise in temperature is about one degree for every 250 ft., so that temperatures of 88 deg. F. (which is the critical fatigue temperature) up to 100 deg. will be the rule. A robust man, however, can work under conditions of great heat, up to 200 deg. F., as long as the air is dry. Unfortunately, the ventilation current, on passing through the shaft, picks up such a load of moisture as to make efficient work almost impossible in the lowest levels, enforcing constant retirement to healthier parts of the mine for recuperation. Already four cases of heat stroke have been noted from this cause.

The amount of air circulating in the Village Deep, which may be taken as a typical deep level mine, is 230,000 cu.ft. per minute, and the total moisture picked up in the mine is 242 tons per diem, of which 127 tons are deposited in the upcast portion of the workings, leaving 115 tons, or less than half the contained load, to reach the surface. The problem is to prevent the

picking up of moisture between the surface and main intakes, which would be equivalent to doubling the quantity of effective air in circulation.

This problem of ventilating deep level workings has for some time been receiving the attention of local scientists, and though so far no satisfactory means of overcoming the difficulty has been evolved, it is certain that among the many methods which are being tried, one will soon be found to answer every purpose. Though contrivances are already in use to lessen the demand on manual labor, the factor of fatigue is one that of itself might determine the limit of profitable mining.

Little is known as to what grade of ore may be expected at greater and greater depths, yet the indications are that although no sensational rise in assay values is to be looked for, the present average grade is likely to be maintained and perhaps surpassed in the South Reef. The question is, will scientific research continue to meet the clamant demand for more economic methods of mining and thus offset the higher working costs which have to be reckoned with when present ore reserves are used up and the deep levels are being depended on to supply most of the tonnage.

Health Conditions in the Rand Gold Mines

The scourge of phthisis, which has been responsible for depleting the personnels of the mines ever since the establishment of the industry, has so far been removed that, though these fields no longer attract the overseas miner, the employers have little difficulty in recruiting men for underground work, largely from the country districts of the Union. About three-quarters of the applicants are of Dutch extraction. Not all who offer themselves, however, are accepted. Indeed, a very big weeding out is done at the Miners' Phthisis Medical Bureau, where, besides the half-yearly examination for which all underground workers must surrender themselves, all candidates for a mining career must undergo a stiff medical examination before they are given the red ticket which spells, or is supposed to spell, physical fitness. Of late, the test has been made more severe, for not only must the applicant have a sound pair of lungs, but he must also show no inherited weakness of these organs predisposing to tuberculosis. Then, his heart is also examined, and the slightest valvular mischief or displacement will be sufficient to disqualify him. If he falls below the standard weight for a given height, this also is sufficient to turn him down.

With all these precautions to eliminate weaklings, which are taken, of course, as much in the interests of the candidate as in behalf of his prospective employer and the insurance company, one would think that the health of the miners would be A-1, and that careful selection, both in a physical and mental, if not a purely educational, sense, would result in a high efficiency and a reduced accident rate. Such, however, is not borne out by experience and hard statistics. Generally speaking, the stamina of white underground workers is not of a high order. Many of them have been previously engaged in widely dissimilar occupations, and do not take kindly to the unnatural conditions obtaining in a mine. The technical schools in conjunction with the practical course of mining in two of the mines are certainly attracting some of the better educated young men, which is all to the good, though not all are cut out for the career they have chosen. Much time and money is often wasted before arrival at this conclusion. On Dec. 31, 1928, 404 apprentices were undergoing the prescribed course at the government miners' training schools, which shows a fair increase over the previous year's enrollment. From the beginning of 1917 to the end of 1928, a total of 793 apprentices completed their indentures. The net yearly cost of running the schools was £39,562, of which £7,640 was contributed by the Union government and £22,922 by the industry. The deplorable shortage of mining graduates is to be dealt with by a joint committee drawn from the university and the Chamber of Mines, which will recommend a modification of the somewhat exacting mining course. This may or may not have the desired effect of attracting more attention to mining as a desirable profession.

The fact is, however, that the mines are not popular, and there is a tendency among the well-educated employees to dodge the spade work as much as possible and trust to back-door promotion. Behind this, no doubt, is the innate fear of contracting phthisis, though, with care, a normal man could under present conditions live out his allotted span underground and never contract the disease.

As if the Rand mines had not sufficient evils to cope with, another disease must needs rear its head and by its ravages serve still further to undermine efficiency. This is the terrible hook-worm infection, which has the effect of emaciating and degenerating its victims and of eventually incapacitating them for work. The hook-worm flourishes in the dark, dirty places of a mine, and its propagation is favored by the heat and moisture. The larva of this worm lives in the soil, moults two or three times, and remains in this condition for several months. For man, this is the dangerous or infecting stage. The infection is largely spread from skips, cages, and ladderways which have been fouled by dirty boots, through contact with the skin of the hands or (in the case of natives) of the feet. The parasite pierces a sweat duct in the skin, giving rise to inflammation and sores known as "ground itch." It then gets into the blood vessels and from them into the lungs and intestines, where it fixes itself to the walls with sharp, hook-life teeth and secretes a poison, at the same time sucking the blood of its host. A nasty customer! But effective steps were taken in the latter part of 1928 to deal with it, and, through the timely activities of a local subcommittee of medical and mining men, this disease has to a great extent been removed from the mines. It is notable that the climatic temperature in South Africa prevents hook-worm getting a lodging on the surface, though it is being imported hither and thither all over the world by human carriers, and flourishes in a zone 35 deg. north and south of the equator.

Increasing Accident Rate in the Rand Gold Mines

For many years the "Accident Prevention Committee," under the ægis of the Rand Mutual Assurance Company, has been conducting an active crusade against carelessness or rashness by underground workers as being the chief factors in causing accidents. It is true, there are certain accidents, mostly of a fatal nature, which no amount of precaution can avoid. A driver of a hauling engine, for example, may be a steady, sober man, well qualified for his job, and may be at his post for many years without having a black mark against him. Then, one day (and who can say why?), his presence of mind fails him, foolproof safety devices go for naught, and the result is, perhaps, an overwind and a cage full of men sent to their death. Then, there is the rock burst or fall of "hanging" which in the present state of min-

ing practice cannot always be foreseen; it gives no obvious warning of its approach and so causes several fatalities every year.

When considering a fluctuating death rate, therefore, we must always take into account that luck or providence plays an important part in determining the ratio of fatal accidents, as opposed to those which are just not fatal, or which could have been avoided by the exercise of common prudence. On this account, to stress a reduction in the death rate as pointing to the steady sinking-in of "safety-first" propaganda is likely to be misleading. Though many minor accidents are doubtless lumped together with the more serious casualties, progress in safety is best ascertained by using the total accident rate as a basis and then analyzing the accidents grouped under their various causes.

The death rate in 1917 was 2.64 per thousand and in 1928 it was reduced to 2.29, which is the lowest figure but one for eleven years. At the same time, it was 2.83 per thousand in 1927 and again 2.29 in 1926, which goes to prove that it must remain a fluctuating figure for the reasons given. When, however, we come to the accident rate, we find that though it stood at 9.89 per thousand in 1917, it increased considerably up to 1921. It then dropped suddenly and appreciably at the time of the big strike and remained constant for two years, which may be accounted for partly by the long forced abstention from work, enabling the employees to get fit, and partly by the fact that a great deal of combing out of inefficients took place on the re-engaging of men. But since 1924 the total accident rate has been increasing rapidly, till in 1928 it stood at 34.56 per thousand, or more than trebling itself in eleven years. To account for this, there was a considerable increase in accidents caused by falls of ground (1,742), to trucks and tramways (1,876), to falling material (1,566), and to miscellaneous causes (1,846), the grand total of accidents from all causes being 7,483.

It is significant that where the number of accidents is expected to be large, the very opposite is actually the case. Those caused by explosives, for example, total 122 and show hardly any increase over the previous year's figure; and of those caused by machinery the same may be said. The reason, I think, is plain. In these two cases safeguards are both possible and numerous, and where the danger is an ever-present one, and always understood, caution becomes second nature. Credit for inculcating safety methods may, therefore, be allowed the Accident Prevention Committee on such heads as these; also for the elimination of many minor accidents, which, although not recorded in detail, cause great losses both to master and man. A mere scratch caused by a broken strand of old wire rope or a rusty nail often leads to weeks of sickness through blood poisoning, and sometimes proves fatal; so much depends on the general state of health of the sufferer.

Consumption of Chromium Expands Rapidly

THE rapid expansion of the consumption of chromium in the United States during the last five years illustrates the rate at which the mineral resources of the world may at any time be called upon to furnish a commodity of whose utilization the civilization of the past had relatively little knowledge, states the U. S. Bureau of Mines. The domestic mining of chromite had its inception in 1827. In that year a commercial deposit of chromite was discovered near Jarrettsville, Harford County, Md. An attempt was made to manufacture paint from this ore, but the effort resulted in financial failure. In 1845 the first successful domestic plant for the utilization of chromite was established near Baltimore. The product was potassium bichromate.

The world's production of chromite has three major oulets—namely, metallurgical, refractory, and chemical.

Chromium steels containing approximately 1 per cent of chromium and 1 per cent of carbon are largely utilized in the manufacture of such articles as shoes and dies, for use in stamp mills and burglar-proof safes. The expanding market for stainless steel and iron is playing its part in the ever-increasing consumption of chromium in the manufacture of steel. In the manufacture of chromium steels and irons, the chromium is added in the form of ferrochrome, which is made from chromite in the electric furnace. In this process the bath tends to take up much carbon, and as carbon is considered undesirable the quality and price are in inverse proportion to the carbon content. In the making of ferrochrome by the methods now in use there is a considerable loss of chromium. It seems reasonable to suppose that research work will before long evolve a method for the utilization of the chromium direct from the chrome ore. Such a process would eliminate the seemingly wasteful step of manufacturing ferrochrome. Chromium is used in steel because it imparts to the alloy the physical qualities of hardness and toughness, a rare combination. Chromium also affects the magnetic properties and very materially increases the resistance of steel to corrosion. The metallurgist requires for his purposes chrome ore of a high degree of purity. The utility of the ore under present practice depends largely on the ratio of chromic oxide to the iron content. Ferrochrome to be acceptable to the trade must contain not less than 60 per cent of chromium.

The metallurgical difficulties encountered in the manufacture of rustless iron (carbon less than 0.12 per cent) are gradually being solved, and it seems that in the near future an alloy will be made on a commercial scale which will withstand corrosion indefinitely. Three processes are now being utilized in the manufacture of rustless iron and rustless steel: (1) The introduction of chromium by means of a very low-carbon ferrochromium; (2) the direct process, in which an electric furnace is used for the reduction of chromite; (3) the gaseous reduction of a mixture of iron ore and chromite to metallic form (for most of the iron and part of the chromium), with subsequent melting to produce the alloy. The present high cost is restricting sales. It is reported that in Germany a process has been developed at a production cost of 5c. per pound. The corresponding figure in the United States is approximately 25c. per pound.

An estimate of the U. S. Geological Survey of the reserves of iron ore in the Lake Superior and Birmingham districts indicates a reserve of grades now used sufficient, at the present rate of consumption, for 30 years, and makes evident the need of the conservation of this most common metal. Any alloy that will materially increase the life of steel should find a ready market.

Extensive Manganese-bearing Lands at Chamberlain, S. D.

Country's Low-Grade Reserves Greatly Increased by Recent Discoveries

OCCURRENCE of manganese ore on ranch lands along the Missouri River at Chamberlain, S. D., was first noted in 1928. Subsequent examination has indicated the existence of a large tonnage, estimated at 50,000,000 tons or more, of manganese-bearing material running 16 per cent manganese and 8 per cent of iron. The following facts are taken from the report made in January, 1929, by John A. Savage & Company, of Duluth, the examining engineers.

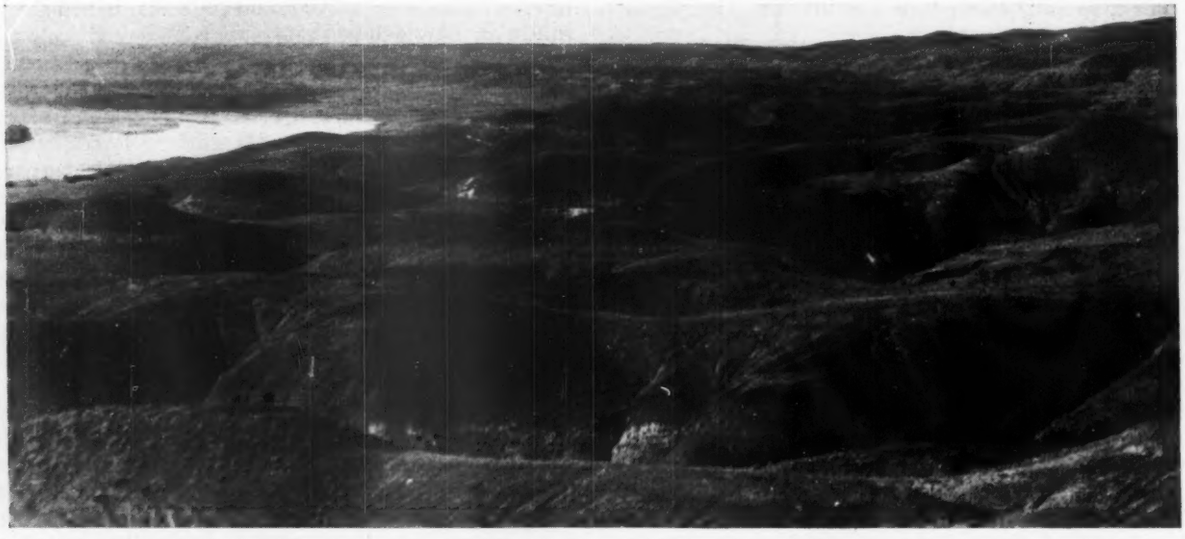
The situation of the manganese-bearing lands is shown in the accompanying map of the Chamberlain area. Bordering the river, they are located in Hughes, Hyde, Buffalo, Brule, and Charles Mix counties on the east bank, and in Gregory, Lyman, and Tripp counties on the west bank. Where these lands are flat they lie at an elevation of about 150 ft. above the river. They are much eroded, however, along the river and its tributary streams.

Within this area, except in the small portion eroded, and in the flat-lying Cretaceous Pierre shales not far above the Niobrara formation[1], a zone of shale about 35 to 40 ft. thick occurs, which contains pieces and chunks of what the examining engineers termed "ore material." This material is light gray in color except where exposed to air, when it soon oxidizes to black. Wherever erosion has stopped at the top of or in this zone, the ground is covered with pieces of this black material, and to the eye these areas, which are of great extent, appear black, as if anthracite had been scattered over the surface. Test pits, 4x4 ft., have been sunk to the bottom of this zone, at various points, the shale permitting ideal test pitting and perfect measurements. The ore material in each vertical 5 ft. was separated from the shale, carefully weighed and sampled, and analyzed by Lerch Brothers, of Crosby, Minn. Results obtained in four of the pits are shown in the accompanying table.

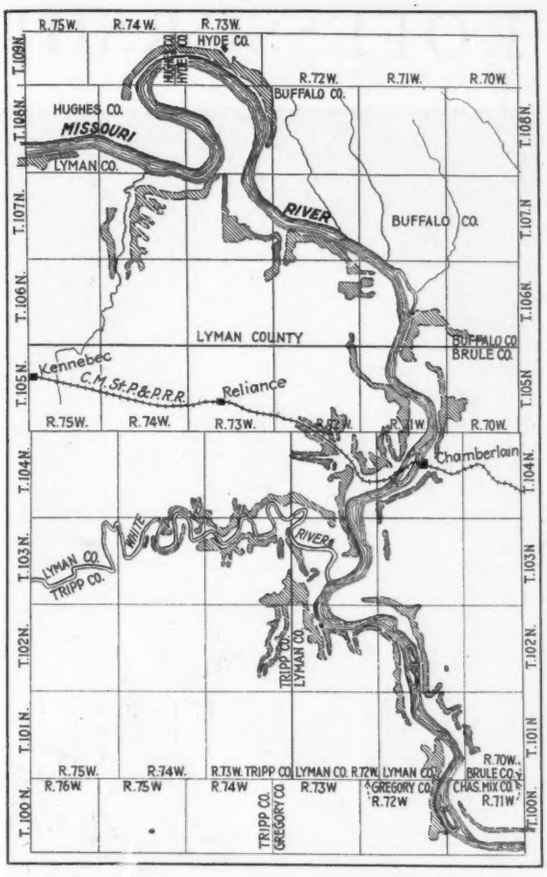
The ore material is a marine-deposited, highly fossilized, non-crystalline carbonate of manganese, iron, calcium, and magnesium. Its manganese content is consistent, and the examining engineers believe that 16 per cent may be relied on. Exposed to the air this gray ore material rapidly oxidizes black. Its specific gravity was found to be 2.5 and that of the shale 1.8. The ore material was probably originally in a series of layers each several inches thick, separated by shale, but the hardening and settling of the shale have scattered it irregularly. Most of the formation is heavily covered with shale, but in the eroded districts a total of 56,000 acres of black spots is estimated. Between the black spots and the high plains large areas with shallow covering occur, and possibly some of this territory near the railroad has more potential value than black spots well removed, because of the factor of transportation.

Similar deposits extend beyond the area mapped, many miles north, west, and south, and probably east under cover, but appear too limited as to tonnage quan-

[1]See Plate VI, U. S. Geological Survey Water Supply Paper 227, by N. H. Darton, 1909, entitled "Geology and Underground Waters of South Dakota."



Some of the extensive black areas in the Chamberlain district. The color is caused by the lumps of dark manganiferous "ore material" scattered over the surface.



Map of the manganese area in the Chamberlain district, South Dakota

tity and too low in manganese content to be worthy of consideration, on the basis of present knowledge.

The engineers' work in 1928 showed clearly that the black top areas are embraced in approximately 56,000 acres, wherein erosion varies from zero to 100 per cent, with a topography varying from flat to ribbed. Four separate 40-acre tracts which showed much variation were surveyed. An acre in which no erosion had taken place would contain over 5,000 tons. On this basis the estimate is made that this acreage contains over 50,000,000 gross tons of ore material analyzing as follows when dried at 212 deg. F.: Iron, 8 per cent; manganese, 16; phosphorus, 0.5; silica, 16; alumina, 2.7; lime, 16; magnesia, 1.8; sulphur, 0.05; loss on ignition, 26, and moisture, 10.

The tonnages in the partly eroded territory and in the territory under high plains are many times 50,000,000 tons. The engineers have been advised by the interests sponsoring the Bradley Fitch process for leaching manganese from its ores that this material, when separated from the shale, is well adapted to their requirements.

Separation of such nodular ore material from hard shale is not done elsewhere, to the knowledge of the examining engineers. The belief is held, however, that it is feasible because of the rapidity with which the shale disintegrates on exposure to the air.

Mining of Andalusite Shown in Film

THE story of the spark plug, from mine to cylinder, is shown in a two-reel motion picture recently issued by the U. S. Bureau of Mines, but the "sound effects," as the engine fires, will presumably have to be imagined by the audience. Of particular interest to mining engineers in this connection is the scene in the rugged Inyo Mountains of California, where the Champion Porcelain Company mines andalusite, which is the raw material used by this manufacturer for the insulator of the plug. This mine was described at some length in the July 18, 1925, issue of the *E.&M.J.* In the film, from a point a mile away across an awe-inspiring canyon, one looks into the mouth of the mine. Drilling and blasting operations are shown and also the loading of the ore on the backs of burros, which transport it down a winding trail to the railroad for the beginning of its transcontinental journey. At the factory, a reserve supply of 2,000 tons of the ore is shown, as are the crushing and pulverizing processes.

Copies of this film, "On the Firing Line; or, the Story of a Spark Plug," may be obtained for exhibition purposes by addressing the Pittsburgh Experiment Station of the U. S. Bureau of Mines, 4,800 Forbes St., Pittsburgh, Pa. No charge is made for the use of the film, but the exhibitor is asked to pay transportation charges.

Table I—Test-Pit Data, Chamberlain, South Dakota

Test Pit No.	Depth, Ft	Sample No.	Pounds of Ore Material	Pounds of Ore Material per Cubic Yard	Cubic Yards per Ton (2,240 Lb.) Ore Material	Iron	Phos.	Mang.	Silica	Alum.	Lime	Magnesia	Sulphur	Loss on Ignition
1	0–5	97	610	...	.....	3.41	0.311	18.12	14.63	1.16	.....	.....	.....	.....
	5–10	98	508	...	.....	4.69	0.389	19.20	13.92	1.11	.....	.....	.....	.....
	10–15	99	956	...	.....	9.06	0.282	15.23	18.61	1.83	.....	.....	.....	.....
	15–20	101	657	...	.....	5.18	0.487	18.04	16.19	1.37	.....	.....	.....	.....
	20–25	102	416	...	.....	4.37	0.455	17.30	23.04	2.41	.....	.....	.....	.....
	25–30	104	894	...	.....	9.55	0.357	14.20	20.06	1.83	.....	.....	.....	.....
	30–35	106	591	...	.....	10.37	0.477	14.30	16.49	2.23	.....	.....	.....	.....
	35–37	...	138	...	.....	.....	.....	14.30	.....	...	.....	.....	.....	.....
	37–42	...	Barren shale	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	0–35 Av.	...	...	223	10.04	7.13	0.381	16.28	17.64	1.70	15.76	1.85	0.050	25.67
2	0–5	108	637	...	.....	3.72	0.356	19.58	13.68	1.25	.....	.....	.....	.....
	5–10	109	602	...	.....	7.77	0.359	17.57	14.85	1.50	.....	.....	.....	.....
	10–15	110	849	...	.....	10.05	0.364	15.84	16.47	1.89	.....	.....	.....	.....
	15–20	111	620	...	.....	8.87	0.431	17.30	17.60	2.07	.....	.....	.....	.....
	20–25	113	722	...	.....	10.21	0.472	14.26	20.12	2.44	.....	.....	.....	.....
	25–30	114	993	...	.....	12.14	0.394	13.20	20.01	2.20	.....	.....	.....	.....
	30–30.9	...	138	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	30.9–35.6	...	Barren shale	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	0–30 Av.	...	...	248	9.03	9.16	0.396	15.97	17.31	1.93	16.05	1.56	0.050	24.75
3	0–5	114	391	...	.....	5.18	0.488	20.72	9.15	2.32	.....	.....	.....	.....
	5–10	116	446	...	.....	16.52	0.336	15.41	11.23	2.82	.....	.....	.....	.....
4	0–5	119	457	...	.....	3.56	0.369	18.52	13.19	2.16	.....	.....	.....	.....
	5–10	120	986	...	.....	12.00	0.248	14.54	16.53	3.29	.....	.....	.....	.....
	10–15	123	588	...	.....	7.14	0.422	18.24	15.09	2.72	.....	.....	.....	.....
	15–20	124	514	...	.....	8.74	0.473	16.27	17.84	4.13	.....	.....	.....	.....
	20–25	125	817	...	.....	13.75	0.378	14.81	13.52	3.79	.....	.....	.....	.....
	25–30	128	308	...	.....	10.56	0.621	16.82	14.06	3.60	.....	.....	.....	.....
	30–36.6	129	148	...	.....	17.34	0.440	12.25	12.45	3.58	.....	.....	.....	.....
	0–30 Av.	...	...	226	9.91	9.98	0.382	16.12	15.19	3.31	.....	.....	.....	25.64

THE COLUMBIA PROFESSORSHIP

Thomas Thornton Read

APPOINTMENT of a graduate of a university to the faculty is singularly appropriate, for he brings more than mere teaching ability or experience: from his student days he retains something of the background and traditions of the school, and it is likely that in his post-graduate days in the field he has kept in touch with the development of his alma mater. A certain objection might be offered to the immediate employment of a graduate on the faculty in that he would bring little that was new to the institution, but that argument cannot be used in the case of Dr. Thomas T. Read, who has just been appointed Professor of Mining at Columbia University after a quarter of a century of experience in various parts of the world.

After graduating from Columbia in 1902, Dr. Read went to the University of Wyoming, where he was instructor in mining and metallurgy for one year and was put in charge of the department the following year. He then returned to Columbia for graduate study, also occupying the post of assistant in mineralogy in 1905, receiving his Ph.D. degree in 1906. After a short term as chief assayer of the Orford Copper Company, at Camden, N. J., the West called again, and he spent a year as Professor of Mining and Metallurgy at Colorado College. Though mining engineers are noted for their globe-trotting, comparatively few have been in China, which was Dr. Read's next stop, for he secured a three-year contract as Professor of Mining and Metallurgy at Pei Yang University, at Tientsin. While there he married the daughter of Dr. A. P. Peck. Returning at the beginning of 1911, he was associate editor of the *Mining & Scientific Press,* of San Francisco, until 1915, when he joined the staff of the mining department of the New Jersey Zinc Company.

During the war, Dr. Read was chief of the Reviewing Unit of the Estimate and Requirements Section of the Army Ordnance and after the armistice, being persuaded that it was at least as patriotic to work for the government in peace time as in war, became a Division Chief of the U. S. Bureau of Mines, with general supervision of the educational work and publication activities. In 1922, he went to South America for six months as the representative of the Department of the Interior at the centenary celebration of the independence of Brazil, returning by way of Argentina and Chile, and was later in charge of the Bureau's work in the north-central district, where he made an economic study of the beneficiation of the lower-grade iron ores. For three years he was in general charge of the mine rescue and safety instruction work of the Bureau, operating ten rescue cars and six stations. Three years ago he returned to New York as Associate Editor of *Mining and Metallurgy,* which position he will continue to hold, and Assistant Executive Director of the American Institute of Mining and Metallurgical Engineers.

In addition to his educational work, Dr. Read has written much on technical subjects and, of recent years, has also contributed to such magazines as the *Atlantic Monthly* and *Harpers.* His calculation of the total work done in the world, showing that half of it is done in the United States, mostly by the power minerals, coal and petroleum, has been widely quoted both in Europe and America. He has also contributed extensively to the discussion of the production control problem in the mineral industry, and never loses an opportunity to urge that mining engineers—or, in other words, the men responsible for the engineering work of the mining industry—must be more than mere technicians if their industry is to continue its amazing contribution to a civilization which is built about the application of minerals better to serve human needs; they must be prepared to meet and solve economic and social problems of major importance. Herbert Hoover has shown that the mining engineer can respond to the call of large responsibilities, and though it is not given to every mining engineer to possess so great ability nor to have such great opportunity for its exercise, the viewpoint is one that every engineer may have.

Dr. Read lives in Scarsdale, N. Y., at no great distance from where he was born, in New Jersey, on Feb. 10, 1880. His family includes two boys and a girl.

Book Reviews

Creating Wants and Satisfying Them

RECENT CHANGES IN THE UNITED STATES. *By a Committee appointed by President Coolidge, under the chairmanship of Herbert Hoover. New York: McGraw-Hill Book Company. Pp. 950; 2 vols. Price $7.50.*

THIS survey, begun in January, 1928, and completed in February, 1929, takes the form of an analysis of post-war developments in American economic life, particularly those that have occurred since the depression of 1920-21. The committee consists of Herbert Hoover, chairman; W. F. Brown, R. W. Dundap, W. Green, J. Klein, J. S. Lawrence, M. Mason, G. McFadden, A. C. Miller, L. E. Pierson, J. J. Raskob, A. W. Shaw, L. J. Taber, D. Willard, C. M. Wooley, O. D. Young, and E. E. Hunt, secretary. It was directed to make a critical appraisal of the factors of stability and instability; to observe and to describe economic conditions in the United States as a whole, suggesting rather than developing recommendations. Mr. Hoover was unable to take part in the later deliberations, and Mr. Shaw served as acting chairman. The investigations were made under the auspices of the National Bureau of Economic Research, with the assistance of several governmental and private agencies.

The outstanding feature of the report was the conclusion that the United States has to date merely touched the fringe of its economic potentialities. "Economically, we have a boundless field ahead of us," the investigators aver, adding that new wants will make way for newer wants as fast as the others are satisfied.

"We have the power to produce and the capital to bring about exchange between the producing and consuming groups. We have communication to speed and spread the influence of ideas. We have swift and dependable transportation. We have an educational system which is steadily raising standards and improving tastes. We have the sciences and arts to help us. We have a great national opportunity.

"Underlying recent developments is an attitude of mind which seems to be characteristically American," says the committee. "Our nation is accustomed to rapid movement, to quick shifts in status; it is receptive to new ideas, ingenious in devices, adaptable. Our economy is in large measure the embodiment of those who have made it.

"Our situation is fortunate, our momentum is remarkable. Yet the organic balance of our economic structure can be maintained only by hard, persistent, intelligent effort, by consideration and sympathy; by mutual confidence and by disposition in the several human parts to work in harmony together."

During the period covered by the survey a large increase has occurred in the use of power. Electricity has penetrated into every section so that the United States now uses as much electrical energy as all the rest of the world put together.

Gains in productivity, with a corresponding increase in consuming power indicate "the expansibility of human wants and desires." "This almost insatiable appetite for goods and services, this abounding production of all things which almost any man can want," is considered as characteristic of the period under review.

Remoteness of a saturation point in satisfying the human wants, the committee maintains, offers one of the great opportunities of the immediate future. In the electrical-appliance industry, despite millions of wired homes, "less than one-third of them had washing machines, slightly more than one-third had vacuum cleaners, less than 5 per cent had electrical refrigerators. . . About 70 per cent of American homes are still without the radio.

"As long as the appetite for goods and services is practically insatiable, as it appears to be, and as long as productivity can be consistently increased, it would seem that we can go on with increasing activity," the report asserts. "But we can do this only if we develop a technique of balance. Toward such a technique the committee believes the skillful work of economists, engineers, and statisticians who prepared the survey on which we have based the facts and interpretations expressed in this brief report, will contribute.

"Our effort has been to suggest a pattern by which their work may be appraised; to set up an orderly plan by which the facts may be articulated, and against which later and better information may be more accurately judged."

Specific subjects considered include "Consumption and the Standards of Living," "Changes in New and Old Industries," "Technical Changes in Manufacturing Industries," "The Changing Structure of Industry," "Construction," "Transportation," "Marketing," "Labor," "Management," "Agriculture," "Price Movements and Related Industrial Changes," "Money and Credit and Their Effect on Business," "Foreign Markets and Foreign Credits," "The National Income and Its Distribution." A review, by W. C. Mitchell, of the National Bureau of Economic Research, concludes the survey, which should be studied by students of economics, particularly in countries foreign to the United States.

A. W. ALLEN.

HISTORY OF MECHANICAL INVENTIONS. *By A. P. Usher. New York: McGraw-Hill Book Company. Pp. 401. Price $5.*

PROFESSOR USHER has performed a useful service in classifying his researches on the position and influence of technology and engineering in the economic history of the world, and in supplying, in chronological order, a scholarly record of major inventions and mechanical developments. In an early chapter the distinction is drawn between discovery and invention, and interesting comments are made on the function of what the author terms the fore-conscious mind. A chapter dealing with the early history of the pure and applied mechanical sciences is followed by details of the mechanical equipment available in pre-Christian times.

Turning, then, to specific inventions, Professor Usher discusses the development of water wheels and windmills, water clocks and mechanical clocks, up until 1500 A. D. An entire chapter is devoted to the life and achievements of Leonardo da Vinci, and another to the invention of printing. Follow interesting details on the development of machines in the textile industry and of precision clocks and watches until the year 1800. Final chapters deal with developments in the production, application, and distribution of power, and with the influence of machine tools and quantity production on modern technical progress. A comprehensive bibliography is appended.

THE SOUTH AFRICAN MINING & ENGINEERING YEAR BOOK AND DIRECTORY—1929 Edition. *London: Argus South African Newspapers, Ltd. Pp. 628. Price 22s. 6d.*

IN ADDITION to a complete review of mining, this volume includes several sections devoted respectively to the topics of base metals, electrical matters, the Congo and Rhodesia, asbestos, engineering and industry, and railway and transport. It contains also a list of the principal engineering concerns in the territory covered, lists of overseas manufacturers, of mining and industrial companies, of buyers, and of consulting engineers and geologists, as well as a buyers' guide to various specialties, and miscellaneous other information. A yearbook of this nature should prove a source of useful information to all those having business or other interests in southern Africa.

METAL STATISTICS, 1929. *New York: American Metal Market. Pp. 568. Price $2.*

The latest edition of this well-known little volume contains the same generous compilation of statistical information concerning ferrous and non-ferrous metals that has been distributed in previous years. Certain new tables and additional data have been introduced further to improve the publication's usefulness. The editors are B. E. V. Luty and J. F. Brady.

USEFUL OPERATING IDEAS

Method of Recovering Sleeve Hole Casing Proves Effective

By Roy H. Poston
St. Francois, Mo.

THE *Engineering and Mining Journal* for Jan. 7, 1928, carried a short article by me entitled "Prospect Drilling in Southeast Missouri," in which a description of the unusual drilling conditions on the Pim tract of the St. Louis Smelting & Refining Works of the National Lead Company, at St. Francois, Mo., was given, together with details of the long pipe sleeves used to help overcome these difficulties. A sketch on page 15 of that issue, entitled "Typical sleeve hole showing necessary pipe casing," shows the details of the pipe casing used.

After the hole has been diamond drilled, an effort is made to recover the 2½-in. inside diameter flush joint casing and the 3-in. o.d. outside casing before the diamond drill is moved to another location. The attempt is generally successful in the use of the 2½-in. casing, but the 3-in. casing is usually so firmly embedded in place, owing to the cement, falling rock, dirt and sludge, on the outside of the pipe, that it cannot be moved with the diamond-drill engine or pump.

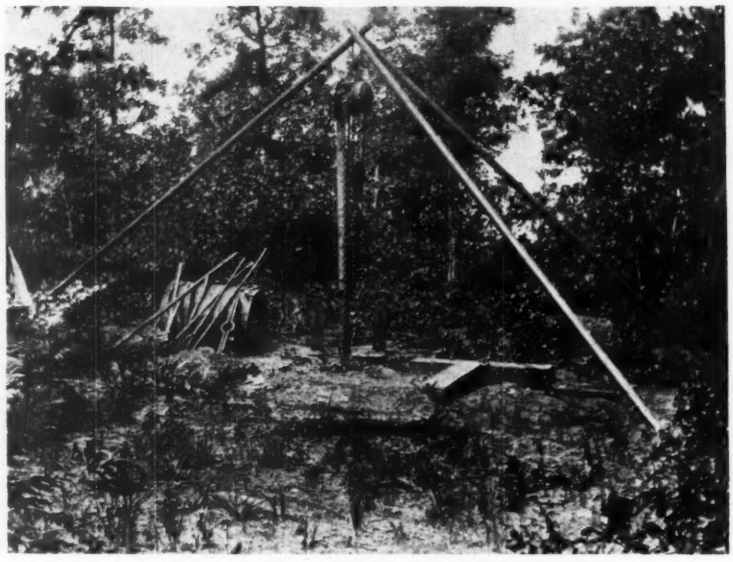
Inasmuch as new 3-in. pipe costs approximately $0.30 per foot at St. Francois, and as the sleeve holes are from 75 to 250 ft. deep, an earnest effort to recover this pipe is worth while. After several schemes had been tried, the method described in the following was adopted. It gives good results at minimum cost. The accompanying illustration shows the necessary equipment assembled and the manner of using it.

A 2-ton chain block is mounted on a 12-ft. pipe tripod, as shown, and two 13-ton hand-operated jacks are used to "break loose" the string of pipe casing before recovery can be started.

Other equipment consists of pipe wrenches, large Stillson wrenches, metal pipe clamps, one 8 by 10 by 60-in. wooden timber, with a 3½-in. hole in its center to fit over the 3-in. casing to be pulled, and miscellaneous small tools, such as a hand hammer, a pick, and a shovel.

In operation, the tripod-mounted chain block is erected over the casing to be pulled and the pipe clamps are fastened to the 3-in. casing. The 13-ton jacks are then placed under the clamps, and an effort is made to loosen the string of casing. If the attempt is successful, the weight of the pipe is held with the chain blocks after each "pull" until the string has been sufficiently loosened to be pulled out, section by section, with the chain blocks without the aid of the jacks. The 60-in. timber is used as a base for the jacks to work upon, as is shown in the illustration at the top of this page.

If the casing is too tightly wedged in the hole to be loosened by the jacks, the only alternative is to try to "break" the casing at some screwed joint by unscrewing the top section and then recovering the sections that may be freed by this "break."



Equipment assembled for recovering diamond-drill sleeve-hole casing

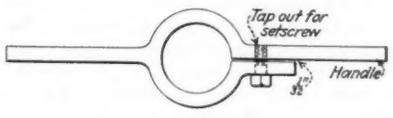
The results of one week's (six days) work is given in the table.

These results were obtained by an operating crew of two men, who worked a total of 104 hours, and one team and driver for moving equipment, who worked 19 hours.

Hole	Sections Recovered	Total Linear Feet Recovered	Value of Casing at 30c. per Ft.
A	1	18	$5.40
B	2	41	12.30
C	1	20	6.00
D	1	13	3.90
E	8	154	46.20
F	6	120	36.00
G	5	97	29.10
7 holes	24	463	$138.90

A Stock for Round Dies

Lacking enough die stocks to supply the repair men, and being unable to get them from the supply house in time, we made some as shown in the cut, writes R. M. Thomas, Denver. They proved better than the ordinary stock,



as they prevented the die from moving in any way. The blacksmith can hammer one out in a short time, after which a drill can be run through the center or the forging can be bored out in a lathe. If an adjustable die is used, a setscrew hole must be drilled in the side of the stock.

Cone-Discharge Control Is Automatic

GENERAL assembly drawings are herewith presented of an automatically controlled distributing cone employed by Dome Mines, South Porcupine, Ont. The cone, details of which have not heretofore been published, is the invention of C. W. Dowsett, formerly of Dome Mines, but now with the Bwana M'Kubwa Copper Mining Company, Bwana M'Kubwa, Northern Rhodesia.

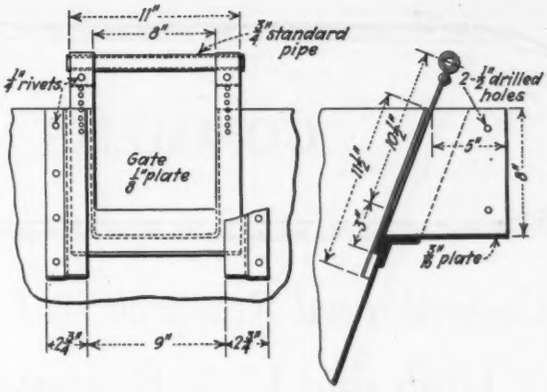


Fig. 2—Details of overflow gates that comprise one of the features of the Dowsett cone

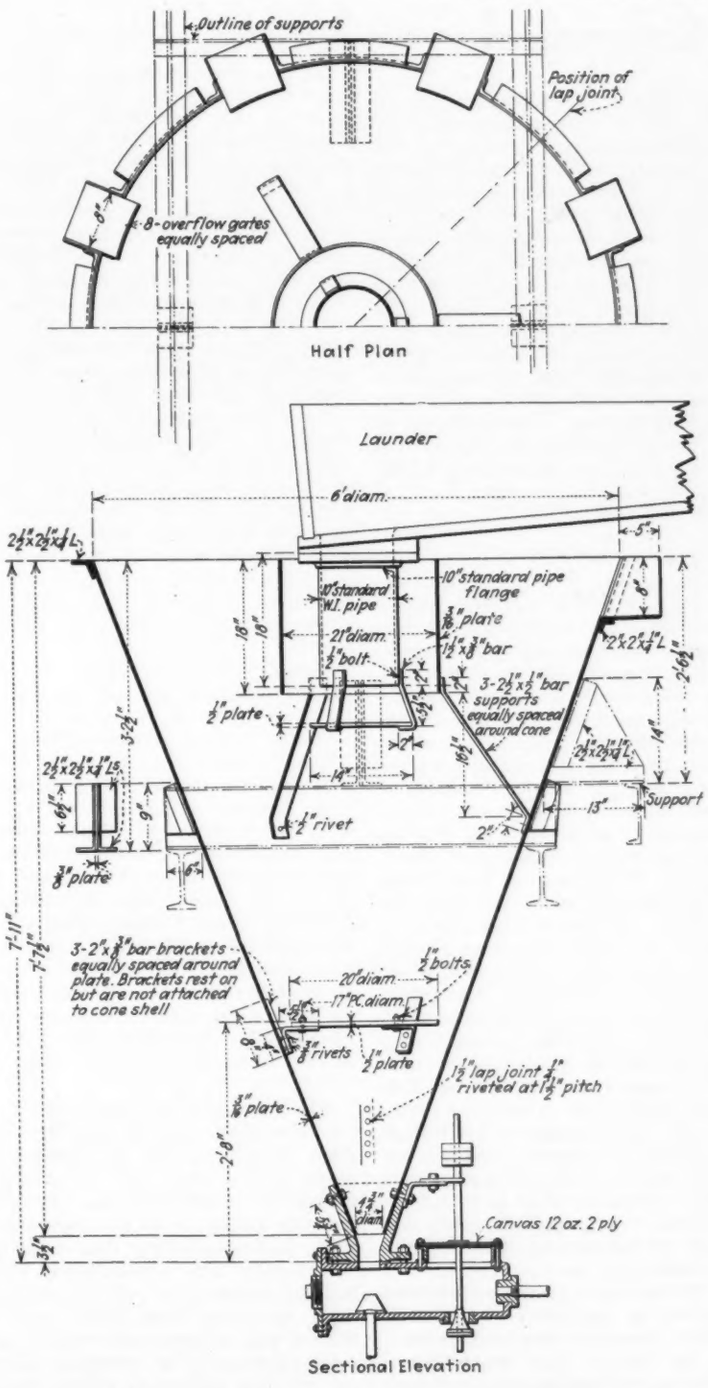
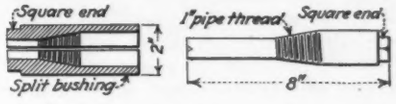


Fig. 1—General assembly drawing of the Dowsett automatically controlled cone

Special control features of the cone result in the total settled contents being periodically moved so that no stagnant zones are formed. At the same time no tendency prevails for some of the finest sand to gradually build up along the side of the cone and eventually pass into the overflow. The accompanying drawings are presented through the courtesy of Dome Mines, Ltd., and Mr. Dowsett.

An Expansion Arbor for Holding Work Tight

NEEDING an expansion arbor that would hold the work from slipping in the lathe, we made one as per illustration, writes R. M. Thomas, of Denver. We first made the bushing, boring it out to allow the 1-in. pipe tap to enter on one end and boring the small end large enough to make a full thread. Next we made the arbor itself, with centers in



both ends, turning it to fit the bore in the bushing and threading it to fit the 1-in. pipe tap hole in the bushing. One end of the bushing and one end of the arbor should be squared so that a wrench can be used to tighten it after the work has been placed on it. The bushing should now be split so it will tighten up on the work. This arbor will hold the work tight in the lathe at all times.

Hardening Small Tools Without Disturbing Fire

If small tools, such as reamers and drills, are to be hardened in the blacksmith forge, they should be placed in a tube or pipe to prevent the fire coming in contact with the steel. They should be turned in this pipe frequently to insure uniform heating. This will also permit the operator to watch the tools to see that the proper heat is applied. By letting the pipe stay in the forge until all the hardening is done, the fire will not be torn up or disturbed.

COMMENT AND CRITICISM

Co-ordinated Research by University of Utah and U. S. Bureau of Mines Proves Efficient and Economical

To the Editor of "E.&M.J.":

Co-operation has contributed generously to progress in the fields of mining and metallurgy. In contrast to the days when companies veiled their operations in secrecy, information is pooled so that when one organization finds a new method, others profit by the enterprise of their neighbor. By this interchange of valuable data, both the practical and the theoretical departments of the industry have immeasurably speeded their progress.

In this connection it is significant that in Utah, where the *entente cordiale* has long existed among operators, a plan of procedure has been developed during the last two years, under the régime of Director Scott Turner of the U. S. Bureau of Mines, that fosters the closest co-operation between the department of mining and metallurgical research of the University of Utah and the Intermountain Station of the U. S. Bureau of Mines, two agencies having the same motives of existence—the advancement of all branches of mining.

So fruitful have been the results of this régime that Utah operators and other mining men from the outside, who have knowledge of the splendid results attained by the co-operative agreement between the University of Utah and the U. S. Bureau of Mines, wonder if the same experiment could not be tried elsewhere with as happy results.

It is not difficult to employ a staff of scientists and set them to work ferreting out fundamental data, but a considerable gap remains to be bridged in order that the laboratory may be of practical value to the mine, mill, and smelter. Operators have long realized the value of the Bureau of Mines, but there have been instances where a more efficient hook-up between the theoretical and the practical man, such as that existing today, might have stimulated progress immeasurably.

Take the development of selective flotation in the Salt Lake Valley district as an example. Years before today's processes were applied with brilliant success to the treatment of zinc-silver-lead ores, a large amount of fundamental data concerning the types of reagents and cells had been accumulated by the Intermountain Station of the U. S. Bureau of Mines and the University of Utah department of mining and metallurgical research. Practically all of the necessary data had been assembled in the laboratory. Proof had been established that selective flotation of lead-zinc ores was possible. But everyone hesitated about applying this knowledge. Selective flotation marked a great stride along theoretical lines, but its value was limited because it was merely a laboratory process. For a number of years, this information lay fallow until a practical man saw its value and built a large flotation plant to prove its practicability and worth.

Today, to prevent the recurrence of any such condition, the experimental work done by the Intermountain Station of the Bureau of Mines and the department of mining and metallurgical research is supervised by one man, one-half of whose salary is paid by the United States and the other half by the University of Utah. Since both agencies are headed for a common goal, the development of the mineral resources of the West, this arrangement saves time and money. The government has no necessity of renting offices and laboratory space. Expenses of heat, light, janitor service and other items are met by the State of Utah. The state also co-operates to assist government work in ways even more substantial. Ten thousand dollars was recently voted by the Utah Legislature for a pyrometallurgical laboratory. The erection of a new Mines School at a cost of over $50,000 is another example of state help in government work. In these structures, the Intermountain Station is allotted space and valuable facilities, entirely free of charge, for all government activities. Through this method, one dollar is made to accomplish results that ordinarily would demand the expenditure of twice that sum.

That the industry may have first-hand information on co-operative research, an advisory board has been organized of leading operators. This group meets with government and university technicians and confers on the needs of the industry. Thoroughly representative of every branch of mining and metallurgy, this board consists of the following: L. S. Cates, vice-president and general manager of the Utah Copper Company; J. O. Elton, manager of the International Smelting Company; W. Mont Ferry, managing director, Silver King Coalition Mines Company; George W. Lambourne, president and general manager of the Park Utah Consolidated Mines Company; W. H. Eardley, assistant manager of the United States Smelting Refining & Mining Company; W. J. O'Connor, manager of the Utah department of the American Smelting & Refining Company; and E. J. Raddatz, president and general manager of the Tintic Standard Mining Company.

In addition, there are subcommittees on flotation, grinding, microscopic work, smelting, and health and safety. These groups meet frequently, interchange information, discuss problems and point out mutual needs, and in this manner the activity of laboratory, mine, mill, and smelter and that of scientist and operator are correlated more closely than was possible when the Intermountain Station and the University of Utah department of mining and metallurgical research were functioning independently.

Out of such co-operation has grown the development of amylxanthate and the knowledge of its selective action on oxides and carbonates of lead. Evolution of a process to float oxidized ores has been vastly speeded through the close entente linking up the operator with the Bureau of Mines scientists. An expenditure of a half million dollars will result, before the summer ends, in the Salt Lake Valley district having a 350-ton plant treating oxidized ores. Through this co-operation, another victory has been won over what seemed an insurmountble obstacle, and millions of tons of ore will be released from a metallurgical ban that not long ago seemed destined to hold for many years.

The co-operative work done by the Intermountain Station and the department of mining and metallurgical research of the University of Utah in the microscopic laboratory has been of invaluable assistance to the mining industry. By establishing data relative to the physical and mineralogical characteristics of complex sulphide and oxide ores, recoveries have been vastly improved and striking economies in power costs effected. The technique of grinding ores has undergone radical revision,

and the industry, through this one activity, has been saved millions of dollars annually in Utah alone.

Under the co-operative agreement existing between federal government and state, so much has already been accomplished, and so much is being projected for this highly efficient system, that Utah operators are looking ahead with the keenest anticipation, confident that a procedure that, in two years, has been the means of securing more from Bureau of Mines' activity than during the last decade, will accomplish much in the future to perpetuate the prosperity of the mining industry.

Salt Lake City, Utah. GAIL MARTIN.

Operative Causes in Ore Deposition

To the Editor of "E.&M.J.":

I read with interest the article by A. R. Fletcher on the Manto deposits of Mexico as well as Basil Prescott's articles on the same subject published previously.

In a paper entitled "Operative Causes in Ore Deposition," in the *Bulletin of the Institution of Mining & Metallurgy,* for October, 1927, I dealt exhaustively with a chemical explanation of the way in which Manto deposits may have been formed and quoted Mr. Prescott's paper. Mr. Fletcher does not mention my paper or my explanation in his last article, and I feel sure that neither he nor Mr. Hulin, who wrote on "The Control of Ore Deposits," knows of the existence of that paper and my explanation.

I write for the purpose of suggesting that your readers' attention be drawn to my paper—the most exhaustive one I know of dealing with the chemical causes of the formation of ore deposits. My reply to the discussion this paper has evoked will appear in the forthcoming *Bulletin* for this month.

Interested readers will find there a criticism of the physical chemistry employed by me in my paper. This criticism is by Dr. Hartley, of University College, London, who undertook the criticism on the advice of Prof. F. G. Donnan, of University College. The criticism, which is thorough, establishes the general soundness of the physical-chemical basis of my paper and justifies consequently the chemistry that I used in building up my various explanations. This searching criticism is one to which previous papers have not been submitted and serves, I submit, at least to establish the physical-chemical soundness of my views and explanations, though it does not establish that, in any one case, mine is *the* correct explanation, for there may be several explanations. H. C. BOYDELL.

Toronto, Ont.

[Readers who are not members of the Institution of Mining & Metallurgy but who wish to read Dr. Boydell's paper and the subsequent discussion should communicate with him at 310-11 McKinnon Building, Toronto, Canada. — EDITOR.]

Tube-Mill Duty on the Rand

To the Editor of "E.&M.J.":

I welcome the letter of "A Reader" in your issue of May 18. It gives me an opportunity of asking you to publish the later information on this subject sent you in a personal letter dated Jan. 22: "Owing to the figures not coming to hand in time, I have been unable to discuss stage fine grinding in this Christmas Letter, but results to hand (from West Springs) show not only a greater output with the twelve tube mills than that obtained by the Modder East, but a materially lower residue, and this from an unscreened and unclassified feed"; and I avail myself of this opportunity to add later details. West Springs now runs twelve tube mills, ten of which are used as primary grinders and two as secondary grinders. The result on fifteen days' consecutive operation yielded an average of 2,400 tons per day, with a final pulp going 80 per cent minus 200 and an average residue value materially lower than that on which the comparative results in my Christmas Letter were based.

But even the above remarkable results fail to enable me to soar beyond my previous comment (to which your anonymous correspondent applies the word "minimize")—"One cannot but be astonished at the extraordinarily efficient results that Davis obtains. Our ideas as to the limitations of tube mills seem to require revising."

London, England. ALFRED JAMES.

Climax Milling Practice

To the Editor of "E.&M.J.":

I have carefully read Mr. Coulter's reply to my inquiry, published in the May 4 issue of *Engineering and Mining Journal,* but find that he has not yet justified the use of the cleaner machine following the rougher machine and preceding the bowl classifier. Also, he states that the tailing of this machine "goes back to the head end of the circuit at the classifiers." This is different from the routing given in the original article, where, in both the line drawing and in the text (top of p. 478, issue of March 23), it is made to return to the rougher machine. If Mr. Coulter's later statement is the correct one, there is an error in the original article.

It is my contention that the use of this cleaner following the rougher is illogical, because in this flotation operation the elimination of middling is not desired. Hence, it is purely a rougher operation and should be so treated. In pulling the first machine very hard, a large amount of barren gangue is carried over. This, according to Mr. Coulter, is eliminated in the cleaner. But what happens to it? It is returned to the original circuit, re-enters the rougher machine, and presumably goes out with the tailing of this machine into the first scavenger. Why not eliminate the cleaner, not pull the rougher so hard, and cause this barren gangue to go to the first scavenger immediately, without giving it a ride around the mill at the company's expense?

I have found Mr. Coulter's remarks interesting and instructive, and it is solely because of this that I wish to continue the discussion.

FRANCIS TARTARON,
Metallurgist,
Vermont Copper Corporation.

South Strafford, Vt.

Designating the Ore-Dressing Engineer

To the Editor of "E.&M.J.":

I have noted the discussions in *Engineering and Mining Journal* relative to ore deposits of such value as to lie on the borderline between the economic and the valueless. My own field being ore dressing, the discussions mentioned have served to call to mind a term, frequently used, but, in my opinion, not yet properly qualified—the term "metallurgy," as used in connection with the technical aspects of the concentration of ores. Also, derived from it we have "metallurgist," designating the person occupied in this connection. The terms "pyrometallurgy" and "hydrometallurgy" are self-explanatory; but, so far as I am aware, no definite prefix has as yet been placed before the word "metallurgy" when used with reference to the concentration of ores.

Therefore, in this connection, I suggest the terms "ore metallurgy" and "ore metallurgist" as logical and possessing the advantage that their significance is immediately apparent to the majority of mining men.

The above is thrown out as a "first shot." Comment by your readers should prove illuminating.

FRANCIS TARTARON,
Ore Metallurgist.

South Strafford, Vt.

Publication Stimulates Research

To the Editor of "E.&M.J.":

In the May 4 issue I noticed an editorial pertaining to the success achieved in the recovery of platinum at Onverwacht, Transvaal, by the amalgamation process evolved by me and described in *Mining and Scientific Press* of Oct. 12, 1918. I appreciate the space in *Mining Journal* in the matter of acknowledgment of credit due for one's effort in attempting to aid in the betterment of the art of platinum metallurgy as well as for the advancement of science.

The appreciation of the profession must also be extended to T. K. Prentice and R. Murdock for their efforts in evolving a suitable *modus operandi* for the treatment of the refractory Onverwacht platinum ores and for their commendable fairness in giving due credit for the source of their information.

VICTOR I. ZACHERT.

San Francisco, Calif.

Digest of Current Literature

Lead Ores. W. Hertel. *Metall und Erz*, first March number, pp. 115-8. Galena is often associated with wulfenite. In the concentrate from such an ore mechanical separation of the components is not feasible, even though considerable difference exists in density. Yet the direct smelting of the concentrate to obtain lead is undesirable, largely because the entire molybdenum content of the wulfenite would be lost in the slag. Hence numerous attempts have been made to effect an economical separation of galena from wulfenite. Several of these are reviewed and compared. A new process has now been worked out, based on the action of hydrochloric acid gas on the ore. The method is a modified procedure from an older idea, which was to convert both the lead and the molybdenum to chlorides and to separate them by their difference in volatility. By the new procedure the idea has been successfully reduced to practice. The concentrate is treated with hydrochloric acid gas in a Heraeus furnace at 380-400 deg. C. The optimum temperature is 390 deg. C. In about 90 minutes all the lead is converted to chloride; in about two hours all the molybdenum is converted to its hydroxychloride and sublimed out of the furnace. The lead chloride is leached from the residue with hot water. The problem of apparatus for large-scale production has yet to be settled; probably a rotary kiln will be found to be satisfactory. It must of course be gas tight and able to withstand exposure to the acid gas. The only byproduct of the process is the sodium sulphate left from making the hydrochloric acid.

Tungsten. H. Alterthum. *Zeitschrift für angewandte Chemie*, March 16, 275-8; March 23, pp. 308-14. Increasing demand for high pressure and temperature apparatus in the process industries has greatly increased the market for tungsten, which is among the most useful components of steels and other alloys required for such apparatus. The principal sources are wolframite and scheelite, found in many parts of the world. Burma, Malaya, China, Korea, and Japan are able to supply the greater part of the world demand; and Australia has extensive scheelite deposits. In the United States occurrence is frequent but widely scattered, and production is much less than consumption. Tungsten ores, on account of their high density, are particularly adapted to concentration by flotation; and magnetic separation is applicable to wolframite on account of its iron content. Methods of working up the prepared ore into tungstic oxide or into the metal or ferrotungsten are described.

Sodium Sulphate. *Chemiker-Zeitung*, March 20, p. 226. Deposits of sodium sulphate, marking the locations of dried-up lakes or seas, occur in Canada and on the Asiatic side of the Caspian Sea. In Spain are found extensive deposits of glauberite, a double sulphate of sodium and calcium. Exploitation of them dates back many years. For commercial production of glauber salt, however, the most important sources are the Canadian deposits, where millions of tons are available, much of it 98.5 per cent pure. Since much of the impurity is organic, calcination yields a product containing 98-99 per cent Na_2SO_4, which could hardly be accomplished even in chemical manufacture of the salt. Even the deposits of lesser purity can be profitably worked if favorably situated with respect to fuel and transportation. Most of the Canadian deposits are in Saskatchewan, among the principal ones being Vincent Lake, Snakehole Lake, Wiseton, Frederik Lake, the Fusilier deposit, and Whiteshore Lake. Many of the deposits were formerly inaccessible, but railways and highways are now bringing them within reach of their markets. Early workings were mostly dependent on solar evaporation, but both coal and oil are now produced within reasonable distance, so that cost of artificial evaporation is not excessive. Production costs being much lower than in the chemical manufacture of glauber salt, the Canadian deposits may have important economic influence in the production of soda, caustic soda, sulphite and bisulphite, sodium sulphide, antichlor, and other chemicals for which glauber salt supplies directly or indirectly a raw material.

Brittle Copper. Clement Blazey. *Metal Industry* (London), March 22, pp. 291-3. Brittleness in copper, generally attributed to presence of small amounts of arsenic, is a grave problem in refining the metal. Samples thoroughly freed from arsenic may be quite brittle; hence the refiners have been forced to seek another cause. It has now been found that even a trace of bismuth may make copper very brittle. As little as 0.004 per cent of bismuth may have a very distinct embrittling effect. Phosphorus and antimony apparently have no relation to the effect of bismuth; but heat treatment does. The embrittling effect of bismuth is associated only with low-temperature annealing. Also noteworthy is the fact that the effect is recurrent after successive heat treatments. Sufficient data on which to base any explanation of the phenomenon are lacking as yet. In discussion, the fact is brought out that bismuth would not have the embrittling effect if associated with oxygen in the copper.

Copper Sulphides. J. G. Joukoff. *Metall und Erz*, second March number, pp. 137-41. In the system copper-sulphur, cuprous sulphide may contain, even at high temperature, more sulphur than required by the formula Cu_2S. This fact led to a study of the solubility of cupric sulphide in cuprous sulphide at 1000-1200 deg. C. The observation was made that cuprous sulphide ores may contain considerable amounts of cupric sulphide; and the melting point is rapidly decreased as the cupric sulphide content rises. In a pure mixture of the two sulphides, the dissociation pressure at the melting point becomes so great at about 16 per cent cupric sulphide that free sulphur begins to distill off. Both sulphides are capable of forming solid solutions, one with the other. These solutions have been studied up to 16 per cent cupric sulphide. In heating these solutions, the temperature rise must be effected cautiously and slowly, or the vapor pressure of sulphur from the system becomes excessive. In metallurgical practice, a practical limit on the solution of cupric in cuprous sulphide is placed at about 16 per cent cupric sulphide, or even lower, on account of this loss of free sulphur. Photomicrographs are shown of etchings (with nitric acid or potassium cyanide) illustrating the appearance of some of the solid solutions of the two sulphides. As the sulphur concentration increases, the fracture changes from a fine grain to a coarse structure with reflecting surfaces.

Reciprocal Metal Displacements. Dauve. *Annales de Chimie Analytique*, January, 1929, pp. 5-9. The theory of obtaining metals from solution by the displacing effect of a metal higher in the electromotive series is presented. The reaction is always exothermic and of course is irreversible. A particularly interesting feature is that the presence of a third metal, which may itself be quite inert so far as displacement is concerned, will in some cases greatly accelerate the action. Noteworthy also is the fact that most metals are not deposited in their natural color. Copper, mercury, silver, and gold are exceptions to this rule. Mechanism of the reaction is discussed.

Oxidation of Copper. W. Feitknecht. *Zeitschrift für Elektrochemie*, March, 1929; pp. 142-51. When copper oxidizes at the surface, most of the oxide is in the cuprous state; only a very thin skin of cupric oxide is formed on the outer surface. The amount of cupric oxide is greater at moderate than at low or high oxidizing temperatures. In processes in which copper is heated in air, the oxide layer first formed is not an effective protection against further oxidation; the cuprous oxide shows crystal growth, like a metal, and diffusion of oxygen occurs through the crystalline formation and along the crystal faces. This behavior is illustrated by photomicrographs.

Molybdenum. A reprint of articles, extracts, and abstracts from various technical publications on the use of molybdenum in industry has recently been prepared by the Climax Molybdenum Company, of 61 Broadway, New York, for free distribution to interested persons. It is entitled "Molybdenum in 1928." A considerable amount of technical data from original published sources is thus collected, mainly on molybdenum steel for various specific uses, such as in aircraft, automobile, and railway construction, and for corrosion-resisting and high-temperature alloys.

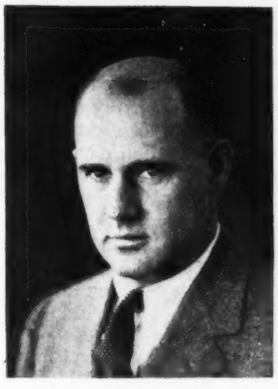
Ore Preparation. A. Götte: *Metall und Erz*, second April number, pp. 185-9. Kühlwein's method of calculating the efficiency of an ore preparation process is inadequate and unreliable because it considers only the relative proportions of particles in the desired size range before and after the treatment. To give a correct estimate, the calculation should also take into consideration the amount of over-fine particles before and after treatment. Based on this principle, a method of calculation is worked out and a formula is developed to express the result of the preparation treatment in terms of the best result which might be expected in practice. A sample calculation is given, with cost estimates based thereon.

Personal Notes

George C. Klug, of Bewick, Moreing & Company, of London, recently inspected mining operations in Montana.

Kirby Thomas is making an examination of properties in Gilpin County, Colo., for Chicago and New York interests.

Louis Ware, until recently general mine superintendent for the Anglo-Chilean Consolidated Nitrate Corporation, at Tocopilla, Chile, where he completed three years in charge of the new electric-shovel program, has returned to the United States. Mr. Ware, who was formerly assistant mine superintendent for Miami Copper, will take a vacation in Kentucky before resuming professional work.



LOUIS WARE

C. Glyn, manager of the Consolidated Main Reef, recently returned to Johannesburg after a trip to Great Britain and Europe.

A. W. Frolli, geologist, of El Paso, Tex., has joined the staff of H. W. Gould & Company, Mills Building, San Francisco.

George A. Packard, mining engineer, of Boston, has completed an examination of mining properties in western Montana.

George H. Garrey recently examined the Piermont mines, near Aurum, Nev., en route to the MacNeill mine, near Palo Verde, Ariz.

Murray Glazier has been appointed engineer in charge of operations at the Thunder Bay Lead & Zinc Company's property, near Port Arthur, Ont.

L. C. Penhoel, president of the Southwestern Engineering Corporation, is in Joplin, Mo., and will return to California after a short stay in Arizona.

Robert Gardiner, who has been superintendent of Cresson Consolidated, in the Cripple Creek district of Colorado, for several years, has resigned, effective June 1.

Prof. **A. P. Coleman** and Prof. **E. S. Moore**, geologists, are in the Sudbury district studying the property of Gordon Lake Holdings, in the southwest end of the Sudbury Basin.

Frederick G. Clapp, of 50 Church St., New York City, has been absent on professional business on a visit to Egypt and other parts of the Near East and has rejoined his family in Paris.

Guy N. Bjorge, consulting mining geologist, of San Francisco, has arrived in New York from Brazil, where he spent several months in professional work for St. John de Rey Mining.

F. J. Mars, who went to Europe to make investigations about the installation of a central power plant for the principal mines at Broken Hill, New South Wales, has returned to Melbourne.

F. E. Calkins has just completed a geologic survey of the Santa Rita district of New Mexico, including a large group of claims on which American Smelting & Refining is undertaking development.

Dr. **E. P. Mathewson**, head of the mine administration course at the University of Arizona, and president of the Arizona section of the A.I.M.E., has been elected president of the Tucson Rotary Club.

M. J. Callow, of General Engineering, is now at Mount Isa Mines, in Queensland, where he will superintend the construction of the metallurgical plants, for the designs of which his company is responsible.

F. A. Linforth, chairman of the Montana section of the A.I.M.E., and geologist with Anaconda Copper, recently addressed the Butte Kiwanis Club on the construction of engineering models for mines, industrial plants, and other buildings.

B. B. Thayer, vice-president of Anaconda Copper Mining, was recently in Butte on a tour of inspection around the company's Utah, Idaho, and Montana properties. He was accompanied by **J. R. Hobbins**, vice-president in charge of Montana operations.

Alfred B. Sabin, engineer for the Lucky Tiger-Combination Gold Mining Company, of Sonora, has just returned to Mexico from a mine examination trip into California, Nevada, and Arizona. He is at present engaged in ore-dressing investigations for the Lucky Tiger.

C. W. Nichols, president of Nichols Copper, which operates a copper refinery at Laurel Hill and is interested in the construction of the new copper refineries in Texas and Quebec, has been elected a director of Nipissing Mines, operating in the Cobalt district, Ontario.

L. Ogilvie Howard, who has been superintendent of the International Smelting plant, at Miami, Ariz., for the last thirteen years, has resigned his position, effective June 1. Mr. Howard first went to Arizona in 1906, as superintendent of the Old Dominion smelter. No successor has as yet been appointed.

Benjamin Beveridge, for eleven years a member of the operating department of the Daly-West and Judge mines, of Park Utah Consolidated, at Park City, Utah, has been made superintendent of New Quincy Mining, and **Guy McKay**, another member of the Park Utah staff, has been appointed engineer at New Quincy.

E. H. ROSE

E. H. Rose has been appointed mill superintendent of the Moctezuma Copper Company's concentrator, at Nacozari, Sonora, Mexico.

OBITUARY

Dr. **James Moir**, government chemist in the Transvaal Department of Mines, died recently at Johannesburg.

James P. Maxwell, who was deputy mine surveyor for the United States at Boulder, Colo., in the 'seventies, died recently at Boulder at the age of 90.

Rudolph Tonn, pioneer mining man in the Central City district of Colorado, died at Denver on May 10. Mr. Tonn was 80 years old and was a native of Germany. He went to Central City in 1875.

Peter G. Grant, mining engineer, of New York, was killed on May 18 when he lost his footing while attempting to board a moving train at Stamford, Conn., and fell beneath the wheels. He was 50 years old.

William M. Fitzhugh, geologist and mining engineer, of San Francisco, died at that city on May 18. He was 75 years old, and was credited with the discovery of the Teapot Dome oil region, in Wyoming.

Henry W. Blake, senior editor of *Electric Railway Journal*, a McGraw-Hill publication, died May 20, 1929. He had been with that publication since 1891, when it was known as *Street Railway Journal* and was devoted to horse-car transportation.

J. J. Wessels died in the Far East Rand hospital on April 6. Mr. Wessels was for many years manager of the properties of Robinson Deep, on the Witwatersrand, and was more recently connected with the Afrikander Lease, Ltd., near Klerskdorp, Transvaal.

J. M. Ruffner, who has been connected with the exploration and development of several of the silver-lead properties in the Atlin district of British Columbia, died at Monmouth, Ill., recently. He was 60 years old. At the time of his death, Mr. Ruffner was on his way to finance development of Atlin Silver-Lead Mines.

INDUSTRIAL PROGRESS

Insuring Safety in Welding—II

Accident Hazards—Adoption of Safe Practices Will Reduce Them to a Minimum

EXPERIENCE shows that the accident hazards of welding incident to property and personnel in the use of the electric arc and gas torch may be minimized by safe methods and practices, protective devices, and proper training.

Fire hazard is not serious in electric arc welding. The nature of the process and the attention demanded of the operator to his work help to prevent the start or spread of fire originating from sparks or molten metal. Fires and explosions are caused mainly by defective apparatus in utilizing the gas torch, and in most cases are preventable. Their order of frequency may be classified as follows:

Gas Fires—These are caused by leaky, defective, or open valves in acetylene tanks. An open valve needs no comment, as its existence is usually the result of pure carelessness. Unless very good ventilation is afforded, escaping acetylene will lie near its source, and the heat from the torch may ignite it. A fire of this kind is hard to extinguish by ordinary methods, but an extinguisher of the carbon-tetrachloride type is considered by many organizations as one of the best means to stop such a blaze. Extinguishers charged with carbon dioxide or carbonic acid gas are also used effectively for this purpose. For such emergencies, welding shops are usually equipped with extinguishers of one of these types.

Gas Explosions—Explosions are also caused by leaky apparatus or careless operation, and are frequently produced by the ignition of a mixture of gases in confined spaces.

Tank Explosions—As most tanks are equiped with safety plugs and built to withstand great pressures, tank explosions are rare. When left in the sunlight or in a very warm temperature, the filled pressure of 1,800 to 2,000 lb. of oxygen may mount up to 2,500 lb. pressure. To obviate this increase of pressure, with the probable blowing out of the safety plug, good practice calls for storing the tanks in a cool place.

Valve Explosions—These are likely to occur in the use of some styles of apparatus, if the operator allows it to get into bad condition. Oil and grease should never be applied to any valve, although a very small amount of pure glycerine is permissible.

The workman presents a more difficult problem to deal with than the apparatus involved. Often the new man is an inexperienced person, who, after convincing the employment manager of his ability, is hired as a welder and is, perhaps, put to work with a few inadequate instructions from the welding foreman. He may know little of the expansion and contraction of hot or cold metals, the technique of the work, or the dangers involved to himself and his fellow workmen through unsafe practices.

Burns resulting from carelessness form the majority of injuries to persons in the welding trade, and frequently the man who gets burned is not the welder. An improperly trained employee may so place heated articles that other workmen, not noticing they are hot, may pick them up, causing serious burns. A properly trained operator will protect his fellow workmen by chalking or marking each job. Although the words "hot metal" may be marked on the metal, this will not help the man who understands no English. In addition to marking properly and safeguarding hot metal, therefore workers of foreign extraction should be told what the words mean, and to look out for them in the shop.

In ordinary arc welding, where currents ranging from 50 to 200 amp. are used, simple precautions are necessary for the protection of the welder's body. All exposed parts of the body are subject to a burning effect similar to sunburn, and unless protected by a covering of some kind, considerable discomfort and pain will result. The usual covering consists of ordinary close-woven clothing and leather gloves, as protection against not only injurious rays but flying globules of hot metal as well. Shields and goggles also serve to protect the eyes from splashes of molten metal. In metallic arc welding, the globule of molten metal is carried across the arc and placed in its seat. This process of deposition permits, with ordinary precaution, a safe method of overhead welding.

In metallic arc welding, where direct current is used with an open-circuit voltage up to 75 volts, little danger is likely from electric shock; but with alternating currents this hazard is more serious, as the operating voltage ranges from 100 to 175 volts. Should the operator become careless while changing electrodes, a severe shock may be sustained. This may be prevented by taking care, when inserting the electrode material, that the operator is not in contact with the other side of the circuit.

This condition applies also to resistance welders, using 450 to 650 volts direct current. In this work the welder must keep free from grounds while changing electrodes. Welding resistors are sometimes equipped with a push-button station, but many welders prefer to take extra precaution in changing electrodes rather than carry this station around.

When a number of small articles are to be welded, involving the use of an automatic welder, it may be advisable to enclose the operation with a cabinet. This cabinet may be equipped with a suitably colored glass window, through which the welding process can be observed.

On piece work, particularly when a number of operatives are required, a series of booths extending above the welders' heads and open at the top is customarily constructed. The welding control apparatus and welding benches are placed at the front of the booths, the backs of which are screened by an asbestos curtain.

Safeguards, as applied to fixtures of similar nature, are used for the protection of welding apparatus, such as circuit breakers, contactors, fuses, inclosed switches, and insulated couplings.

Safe Practices Recommended in Oxyacetylene Welding

Many of the larger plants and shops where oxyacetylene welding is conducted observe certain precautions for the promotion of safety. These practices, affecting the most common accident hazards of oxyacetylene welding, may be summarized as follows:

1. Separate storage places provided for oxygen and acetylene cylinders, in cool places, avoiding exposure to the sun.

2. Careful handling of cylinders, as rough handling is conducive to leaks, which often result in explosions. No attempt should be made to repair a leaking acetylene tank, and such tanks should be removed to the open, away from fire.

3. Suitable markings for cylinders, according to the gas contained.

4. Cylinders stood on end while discharging, and not exposed to sparks or flame.

5. The use of oil or grease on all cylinder or regulator connections prohibited, as well as the dropping of cyl-

inders on oily areas of the ground and the avoidance of leaking oil lines.

6. A high-grade hose used to avoid early disintegration and the clogging of valves and fittings.

7. A thorough inspection and cleaning made frequently of hose, fittings, and apparatus.

8. Blowing out hose before connections are made between regulator and torch.

9. Couplings and fittings wiped off with a clean cloth before connecting, but not with a piece of waste, a soiled rag, or with gloves.

10. Regulators fitted properly to cylinders, preventing the crossing of threads, and the needle-valve packing nuts screwed tightly to prevent leaking. The difference in threads of cylinders must be understood: right hand for oxygen cylinders and left hand for hydrogen cylinders.

11. Torch kept inside field of vision and care exercised in directing the flame to prevent sparks falling on workmen or hose.

12. Strong drafts avoided to prevent cracking of the work.

13. Both valves shut off immediately when a back-fire occurs—first the oxygen, then the acetylene. The blowpipe should be cool before relighting and the carbon blown out by turning on the oxygen. If cooled in water, the oxygen should be allowed to bubble up slowly to prevent water entering the blowpipe.

14. Instructions as given by the manufacturers should be followed closely in lighting. In an emergency, a torch may be lit from a burning match on the ground, but never from the hand.

15. Valves always completely shut off before hanging up torch.

16. Care observed in the handling of spare parts and regulators not in service. It is important that these be not thrown carelessly about or in a way to come in contact with greasy or dirty materials.

Some Hazards Common to Both Processes

Some of the common hazards peculiar to both electric and gas-torch welding are:

1. Insufficient or no ventilation of booths or rooms to exhaust smoke, fumes, and gases.

2. The use of improper goggles, garments, shields, or devices for protecting the operator and other workmen.

3. Failing to indicate or mark hot metal or stock.

4. Supporting work on gas cylinders, oil barrels, or containers.

5. Falling material which has been cut off.

6. Neglecting to open cavities to permit the escape of heated air and gas when preheating cored iron castings.

7. Cutting or welding a container which has held a combustible liquid or gas without proper cleansing.

8. Insufficient training and instruction of operators in the technique of welding, and the lack of precautionary measures to educate employees in the hazards of the welding shop.

A Suggestion as to Those Learning to Weld

In plants where welding equipment is used, it is suggested that workmen applying for jobs and claiming experience as welders undergo a test for proficiency, and a course of lessons be undertaken by all beginners. This can be accomplished if the welding foreman will examine personally the qualifications and abilities of all applicants and lay out an instructional course for the beginners.

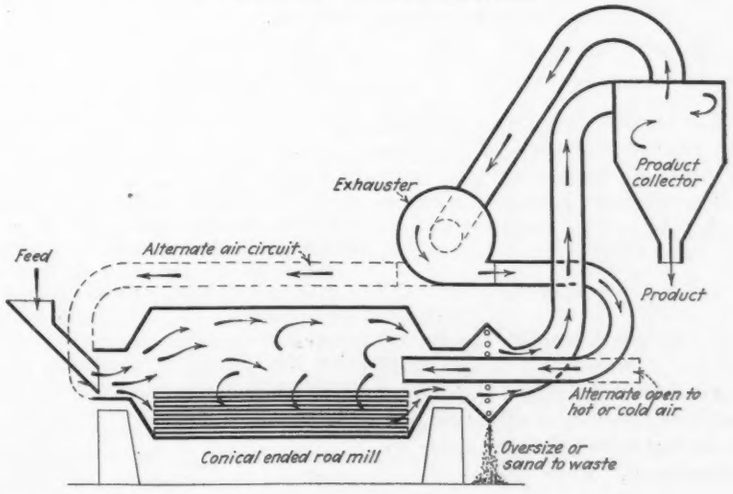
Many of the welding-equipment manufacturers provide handbooks and manuals outlining lessons in welding, and it is believed that lower operating costs and better workmanship will result after the fundamentals of welding have been learned as thus presented. To become expert in welding, a large amount of practical experience is necessary, and, as with any other mechanical craft, considerable application and study are required.

Improved Way of Separating Asbestos Fiber Sought

INTERESTING experiments and departures from older methods of separating asbestos fiber from inclosing matrix or gangue have been in progress for over a year in the Hardinge Company's laboratory at York, Pa., and also in the company's air separating mills installed at the Columbia University laboratory in New York City. Similar tests have been made at the Department of Mines, Ottawa, Canada, all tending to the same end—namely, the obtaining of as long a fiber as possible. More detailed data will be given as soon as further experiments confirm those already made by crushing in both ball and rod mills.

The method utilizes air flotation in the same manner that it is used in crushing coal and ceramic materials. The conical ended rod mill adapts itself particularly to this separation, owing to the increased acceleration of air through the cone and consequent ability to lift the longer fiber while the crushed rock or gangue is being separated at the outlet. The fiber does not pass through the fan, the clogging and wear of the blades as well as undue "punishing" of the fiber thus being obviated. This system, if successful, may displace the older and more complicated methods of separating the fiber from the rock.

Sketch illustrating proposed new method of separating asbestos fiber by air flotation in conical ended mill



BULLETINS

Water Wheels—The James Leffel & Company, Springfield, Mass. Bulletin No. W202. Four pages.

Crane—American Hoist & Derrick Company, St. Paul, Minn. "American" gasoline three-speed crane. Eight pages.

Explosives—Hercules Powder Company, Inc., Wilmington, Del. Bulletin Hercoal-F, a new type explosive. Fourteen pages.

Core Drilling—Sprague & Henwood, Inc., 221 West Olive St., Scranton, Pa. Circular No. 29A, core drills and supplies. Eight pages.

Altimetry—The American Paulin System, Inc., Educational Division, 1220 Maple Ave., Los Angeles, Calif. Manual on altimetry. Sixteen pages.

Motors—General Electric Company, Schenectady, N. Y. Bulletin No. GEA-517B, totally inclosed, fan-cooled D-C motors Type CD. Four pages.

Crushing Equipment—Smith Engineering Works, Capitol Drive at Holston St., Milwaukee, Wis. Bulletin No. 264 B, Telsmith jaw crushers. Twelve pages.

Stoker—Combustion Engineering Corporation, International Combustion Building, 200 Madison Ave., New York City. Catalog K-2, Type K stoker. Fifteen pages.

Diesel Engine—Chicago Pneumatic Tool Company, 6 East 44th St., New York City. Bulletin No. 775, Chicago Pneumatic M.W.M. Benz Diesel Engines, Type RH-75. Twenty-four pages.

NEWS OF THE WEEK

Summary

THE U. S. Bureau of Mines will study milling methods along the same procedure that characterizes the study of mining methods now under way. Bureau issues information circular on geophysical prospecting. Page 853.

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The railroad to Mount Isa, from Duchess, Queensland, is now open, having been dedicated last month. Page 857.

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Governor Young of California vetoed the Seawell hydraulic mining bill after it had finally been passed by the state Legislature. Page 856.

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Wright-Hargreaves has cut mill tonnage down to 350 tons daily, in accord with plans prepared by M. W. Summerhayes, the new manager. Page 853.

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Connections have been made between the Mond and International shafts of International Nickel, at the Frood mine, in the Sudbury district. Page 855.

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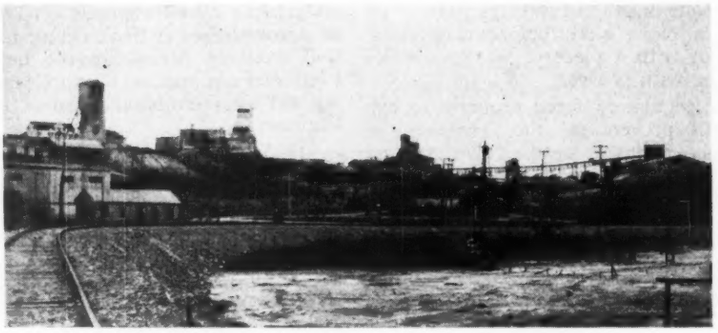
Utah Copper makes new record of production by mining 141,586 tons in a single day of two shifts (sixteen hours). Of this amount about 74,000 tons was ore. Page 854.

* * *

A 420 g.p.m. pump was shipped to the Eighty-five mine of Calumet & Arizona, at Valedon, N. M., from the Worthington Pump works at Holyoke, Mass., in record time recently. Page 856.

* * *

T. W. Gibson, Deputy Minister of Mines for Ontario, has been made advisory consultant and T. F. Sutherland will take over most of his present duties in important changes made by the department. Page 857.



The Hollinger mine, in the Porcupine district

L. C. Graton to Inspect Hollinger, Now Producing at Half Mill Capacity

L. C. GRATON, professor of mining geology at Harvard University, and an authority on mining at depth in the gold producers of Brazil, South Africa, and India, has been engaged to make an inspection of the properties of Hollinger Consolidated, in the Porcupine district of Ontario, according to an announcement made at the annual shareholders' meeting of the company, recently held in Montreal. This step is regarded as of extreme importance in connection with the future of the mine. Mill tonnage is now down to 4,000 daily, which is only half of capacity. The reason for this drop was stated at the meeting to be disappointing development results on the lower levels of the mine.

At present, Hollinger has 125 drills working, of which about 70 drills are on production and 55 on development work. The company is now cutting down the development and exploration program and switching as many drills as possible back to production. Noah Timmins, president of the company, stated that cutting down development work would result in larger profits. Mr. Graton, it was stated, will send a staff of men to the property and will also spend considerable time there himself. He recently acted in an advisory capacity to St. John del Rey, the Brazilian gold producer.

Earnings for the year to date have not been sufficient to meet the dividend requirements of 5c. on nearly 5,000,000 shares every four weeks. However, with the change in policy as regards exploration work, the company should be in a position to make up the difference between profits and dividends.

In reference to the construction of a railroad to Kamiskotia, Mr. Timmins said that the railroad wanted certain guarantees, which Hollinger refused to grant. Subsequent to the meeting of the company, however, the directors received new proposals from the railroad for the building of a branch line from Timmins, Ont., to the property. Hollinger is prepared to build a concentrator if the railroad will extend the line, and the understanding is that the new proposal does not include the guarantees which were originally refused. Work done at Kamiskotia to date is said to have developed 1,000,000 tons of ore carrying copper and zinc.

Supreme Court to Review Decision in Flotation Suit

The U. S. Supreme Court has granted Minerals Separation of North America a review of the Circuit Court of Appeals decision in favor of Magma Copper in the suit brought by the former charging infringement of flotation patents. The Circuit Court reversed the decision of the U. S. district court of Maine, made in February, 1928, in favor of Minerals Separation.

Butte Copper Con. Strikes New Orebody on No. 5 Level

At the properties of the Butte Copper Consolidated Mines, at Radersburg, Mont., the long drift on the No. 5 level has been advanced to a point 520 ft. southeast of the shaft and has picked up another orebody which has not been prospected on the levels above. The station in the No. 6 level has been cut and a crosscut is being driven to tap the orebodies which showed above.

Bureau of Mines to Study Milling Methods

By Paul Wooton
Washington Correspondent

A STUDY of milling methods and costs has just been started by the U. S. Bureau of Mines. It will follow the lines of the study used in compiling facts as to methods and costs of mining. Mill superintendents and engineers in the different mining districts are being asked for information regarding milling practice and costs. This study is expected to be advantageous to operators in comparing their results with those of similar mills and in addition will bring out a mass of details and interesting stunts which have been developed at individual plants.

The Bureau has just issued Information Circular No. 1, dealing with geophysical prospecting. This circular contains abstracts from the most recent publications and articles dealing with the subject. The circulars are being issued under the immediate supervision of Frederick W. Lee. This first issue contains a list of 25 prominent engineers who have consented to serve as contributing editors for these abstracts. The list follows: W. Ayvazoglou, Bureau of Mines; Dr. D. C. Barton, Houston; Dr. A. S. Eve, Montreal; Dr. Paul D. Foote, Pittsburgh; Dr. O. H. Gish, Washington, D. C.; Kenneth Hartley, Houston; Prof. W. Spencer Hutchinson, Cambridge, Mass.; Dr. W. P. Jenny, Houston; Dr. J. C. Karcher, New York City; Dr. D. A. Keys, Montreal; Dr. R. S. Knappen, Tulsa; Prof. Alfred C. Lane, Boston; Dr. F. W. Lee, Washington, D. C.; E. C. Léonardon, New York City; Prof. Donald H. McLaughlin, Cambridge, Mass.; Dr. C. E. Van Ostrand, Washington, D. C.; Dr. I. Roman, New York City; Dr. A. E. Ruark, Pittsburgh; Louis A. Scholl, Houston; Dr. Karl Sundberg, Houston; O. H. Truemann, Houston; Paul Weaver, Houston; Dr. A. von Weelden, Dallas; Dr. F. E. Wright, Washington, D. C.; and Dr. Theodor Zuschlag, New York City.

To confirm theories used in geophysical prospecting which hitherto have been partly speculative, the Bureau of Mines is about to undertake test studies in the Kentucky caves, starting early in June. By using instruments both above ground and in the caves, it will be possible to check the penetration of magnetic fields and of current fields and thus to discover what absorption takes place and the limits of penetration under natural conditions. The results will apply to most geophysical prospecting procedure now in use, including radio methods. Preliminary reconnaissance has been made to locate caves without wires, rails, or pipes which would carry current and hamper the work.

The Canadian Geological Survey is sending Dr. A. S. Eve and Dr. D. A. Keys, of the University of Montreal, to co-operate in the investigations. Dr. F. W. Lee, supervising engineer of the geophysical section of the Bureau, will work jointly with the Canadians.

Crown Reserve Closes Mine at Larder Lake Permanently

Equipment on the Crown Reserve property, at Larder Lake, Ont., is being offered for sale, and the company has finally given up all hope of developing the mine. Approximately $50,000 is expected to be realized, and this sum, together with the small surplus left in the treasury, will be used for the purchase of mining stocks with the purpose of eventually building up a substantial sum. During the last two years about $325,000 has been spent in development work on the property, but it was found that the new levels opened up at depth gave very disappointing results. In the upper levels about 150,000 tons of ore averaging $6 has been proved up.

Wright-Hargreaves Cuts Mill Tonnage to 350 Daily

Tonnage at the Wright-Hargreaves mine, in Kirkland Lake, Ontario, has been reduced to the capacity of one mill unit, or 350 tons a day. This cut was in line with the report made by M. W. Summerhayes, who is now general manager of the property. Preparations are being made for an intensive development campaign which will include the opening up of new levels. The proposed development program is expected to take about two years to complete.

Consolidated M. & S. Starts Work on Gladstone Mountain

Work has been started on the Gladstone Mountain lead mine, at Northport, Wash., which Consolidated Mining & Smelting optioned this winter. A diamond drill has been sent to the property, and work has been started on insuring a water supply by constructing a pipe line from Republic Creek. The property had been idle for several months, although it was the largest lead producer in the State of Washington in 1928. Consolidated will also operate the adjoining Electric Point mine.

International Pushing Work at Park Premier Property

Operations at the Park Premier property, in the East Park City district, Utah, controlled by International Smelting, are being carried on at three points. The Park Premier tunnel is being enlarged, a churn-drill hole is being put down 1,000 ft. northwest of the face, and the Park Konold shaft is being unwatered. Heavy equipment will be installed at the Park Premier shaft at once.

One churn-drill hole, put down in Nelson Gulch through the rhyolite flow, struck strong mineralization, including copper and iron.

C. & A. to Build New Power Plant at Junction Shaft

Globe, Ariz., May 20, 1929.—Calumet & Arizona Mining announces that $470,000 will be spent for a new steam power plant at its Junction shaft, in the Bisbee district, to replace the present plant. The new boilers will carry 450 lb. pressure per square inch. The turbines will develop 350 kva. power capacity. A new electric hoist, being built by Allis-Chalmers for the Campbell shaft, will arive in Bisbee in June.

Lease Ground in Pinnacle Mine, at Cripple Creek

ABOUT 35 per cent of the total acreage of the Pinnacle mine, operated by Mexican Gold & Silver Mining, in the Cripple Creek district, Colorado, has been leased to Consolidated-Virginia and Ophir Mining. Operations of the two leasing companies will be conducted through the 300 level of the Whipp and Glenn shaft, which is being electrified. Mexican Gold & Silver Mining will operate through the Mitchell shaft, which is being deepened 200 ft.

N'Changa to Sink Main Shaft to Depth of 640 Ft.

N'Changa Copper Mines, operating in the N'Dola district of Northern Rhodesia, will sink its main vertical shaft, on the main lode of its property, to a depth of 640 ft. and will start development of the property on the 600 level. The shaft is now down 256 ft., and the lowest lateral workings are at 150 ft. Some work has been done on the 300 level of the new vertical shaft.

Miami and Inspiration Give $4,000 in Safety Prizes

Inspiration and Miami, the two largest copper producers in the Globe-Miami district of Arizona, have recently finished a series of first-aid contests in which a total of about $4,000 has been distributed as prizes. Each man of the team placed first in each contest received $30; in second-place teams, $25; third-place teams, $20; fourth-place teams, $15; fifth-place teams, $10; and teams placed, below fifth, but having a better average score than 80, $5.

California Cement Men Win

Eight cement company officials, held in contempt by the California Senate, were freed on May 14, 1929, by a decision of the State Supreme Court. The decision upholds the right of the State Senate to find guilty of contempt in a general way, but as it failed to set forth proper facts the company officials were liberated.

New Raise to Increase Output at New Quincy

ANOTHER working raise is being driven by New Quincy Mining at its properties in the Park City district, Utah. A. L. Hurley, manager of the company, expects to have it completed by June 1. The output of the company will then be increased to 200 tons daily. Production is coming from the Janney horizon in the Park City limestone, about 114 ft. above the Weber quartzite. Five oreshoots have been opened up in this stratum at intervals of about 1,000 ft. along the strike of the bed. Only 10 per cent of this total is estimated to have been worked.

In stope 1,241, from which most of the production is coming, the oreshoot is 15 to 20 ft. wide and 10 to 12 ft. thick. About 200 ft. distant is stope 1,236 east, where 8 to 10 ft. of ore is exposed. In stope 1,219 a deposit has been opened up 350 ft. from 1,241 in parallel fissure. At stope 1,242, 125 ft. east of 1,236, the company is developing an oreshoot 3½ ft. thick and 20 ft. wide.

Tintic Companies Opening Area Near Desert Claim

OPERATIONS of Chief Consolidated and North Lily, in the East Tintic district, near Dividend, Utah, are opening up strong mineralization in a fault block that should contain the truncated deposit of the North Lily, in or near the Desert or Tintic Bullion claims. To develop this area, Chief Consolidated sunk a winze from the North Lily 900 level to the 1,200 level. Drifting in the quartzite opened up a strongly mineralized area, both in Chief Consolidated and North Lily ground, within a short radius of the winze. A raise put up in Chief territory struck high-grade ore, which did not persist.

Development was then started on the 900 level and a favorable footwall formation has been exposed. Now the company has opened up 4 ft. of ore on the 1,000 level in the quartzite believed to border the Ophir formation. North Lily has struck a strongly mineralized area in a raise from the 1,200 level near the Chief winze.

Seneca Producing From Area Near No. 1 Shaft

SENECA has three levels which are furnishing sufficient rock for one stamp head while development work is in progress at its mine in the Michigan copper district. Rock from No. 1 shaft is responsible for the reported yield of 31.5 lb. of copper per ton. Grade has been consistent on both sides of the shaft, and in view of the high-grade ground in both Ahmeek and Mohawk, adjoining, similar conditions are expected to prevail in Seneca as the mine is opened further. Good progress is being made in No. 2 shaft in completing the shaft between the 19th and 25th levels, completion of which will permit the driving of additional drifts in promising territory.

One of the next steps in the development program will be the resumption of drifting in the 11th and 13th levels north from No. 3 shaft. The 13th is connected with No. 2, through which the 11th and 13th will be worked. Meanwhile the 3d level drift from No. 1 is being pushed northward beyond No. 2 to prove up the extensive area in that direction at depth.

Utah Copper Handled 141,586 Tons on May 16

A NEW record of production was made at the Bingham mine of Utah Copper on May 16, when 141,586 tons of rock, or 1,770 carloads, was moved in two shifts, or sixteen hours. This included 73,788 tons of ore and 67,798 tons of waste. About 100,000 lb. of copper is being recovered daily at the central precipitating plant at Copperton.

Utah Copper's silver-lead property in the limestone portion of its mine, near the United States mine, is producing 200 tons daily of ore which returns the company a net of about $10 a ton. A large tonnage of this ore has been developed, assuring shipments of this size for some time.

Michigan Passes Law on Tailing Dumps in Lake

Provided the Governor of Michigan signs the relicted land bill, which was passed by the state Legislature, no further question of ownership of copper stamp tailing on waters bordering Lake Superior can arise. The Michigan supreme court in recent decisions has held that all the lands left by the receding of water are the property of the public, held in trust by the state for the people.

The bill passed by the recent Legislature abolishes the old meander line that marked the riparian boundary and extends the boundary to the shore line.

Will Develop Copper Mines in Patagonia Mountains

ARIZONA Consolidated Copper has had the Molly Gibson and Chief properties, situated in the Patagonia Mountains of Santa Cruz County, Ariz., examined by Dwight E. Woodbridge, of Duluth, and has also had them surveyed electromagnetically by the Radiore Company, of Los Angeles. As a result of these examinations the company has decided to do some exploration work.

The president of Arizona Consolidated is Lycurgus Lindsay, formerly president of the First National Bank of Nogales. G. J. Snook is treasurer. The late Bracey Curtis was the first treasurer of the organization. The company is said to be fully financed.

Development of Horn Silver Mine Results Favorably

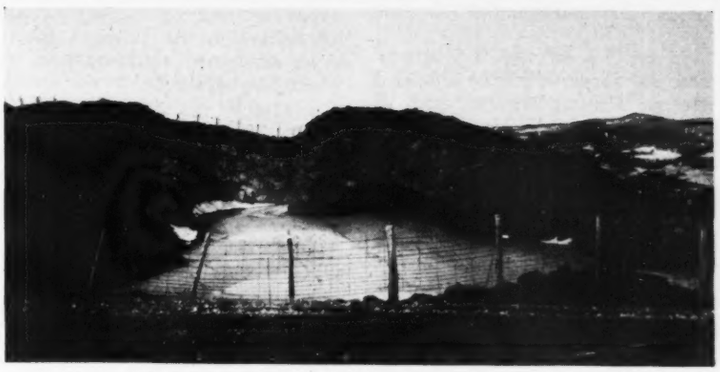
PROSPECTING and reopening of the old Horn Silver mine, in Beaver County, Utah, by Tintic Lead, is yielding favorable results. In the vicinity of the orebody that produced more than $50,000,000 from an area of about 10,000 sq.ft. down to the 1,000 level, eight deposits have been opened up. On the 900 level the company has explored three oreshoots close to the old workings. In the Blue Room, a deposit 20 ft. thick is being stoped that shows high-grade lead-zinc ore, with some silver and gold. On the 700 level the company is opening up a large copper sulphate deposit which carries streaks of high-grade ore and on the 600 level a deposit is being followed into virgin ground which carries copper, lead and silver.

Many interesting facts are being learned about the old mine. Its underground workings total only 4 or 5 miles, as compared with the 40 or 50 miles that are ordinarily run in a Utah mine boasting the same production record. Little crosscutting was done by the "old-timers." The ore was followed along the north-south strike of the trachyte-limestone contact, but only a limited amount of crosscutting was done to determine the ore formation of the deposit. That such crosscutting could have been done with profit is indicated by the recent discovery of an orebody from which three carloads have been shipped after driving only 3 ft. This deposit assayed 30 oz. of silver and 8 per cent lead, and the management believes that by following it a large deposit in virgin limestone may be opened up.

On the 900 level the oreshoot had a length of 6,000 ft., when it abruptly came to an end. No work was done by the old-time operators to find if this ore plunged westward, although no gradation of content from high to lean was apparent. Crosscutting and raising already started on the 1,000 level should discover the ore if it persists to depth.

Old records of the mine show under what handicaps the "old-timers" operated. Ore assaying 25 per cent lead, 25 to 30 per cent copper, and 80 oz. of silver to the ton, when shipped, netted the company only $14.12 a ton. Copper was penalized and no gold determination was made by the smelter in those days.

The mine has been thoroughly rehabilitated. Headings that were mere rat holes, choked with timbers, débris, and boulders from several cave-ins, have been opened up and retimbered, steel has been relaid and water and air lines have been installed to strategic points. In places the dust was ankle deep and had to be washed down old stopes and winzes before men could work without being suffocated. A. E. Kipps is manager of operations and Phillip Clark is in charge of leasing operations.



Above—The Mond shaft at the Frood mine, in the Sudbury district. Below—The open pit from which the first Frood ore was extracted.

Two Shafts at Frood Are Connected on Two Levels

DRIVING in opposite directions, a crew of International Nickel last week completed the connection between the Mond and International shafts of the Frood mine at the 2,400 and 2,800 levels. When the two nickel producers in the Sudbury district were merged, the joint operation of the Frood mine became a certainty. Illustrating the accuracy with which the drifts were cut, on both levels the drifts met exactly head on. This is the first underground connection that has been made between the two sections of the Frood, and it marks an important stage in the advance of the work of opening up the mine for large-scale operation. The two shafts are about 2,500 ft. apart.

Premier Reveals Negotiations With B. C. Silver

PREMIER GOLD recently made public for the first time the negotiations between it and B. C. Silver Mines, started in the summer of 1927, and has defined the present status between the two companies. H. A. Guess, managing director of Premier, arranged with C. A. Banks, managing director of B. C. Silver, for Premier engineers to examine and sample the B. C. Silver mine and for Mr. Banks and his engineers to examine and sample the Premier. The result of its examination did not warrant the Premier company in making an offer of Premier shares for B. C. Silver mine that either Mr. Banks or his company was likely to consider, but, to facilitate matters and because Premier owned approximately 38 per cent of the B. C. Silver stock, it offered to mine and mill the ore on the following terms: $3 per ton for the first 50,000 tons, $2.50 per ton for the second 50,000 tons, and $2 per ton for the next 50,000 tons, and on ore suitable for shipping without milling 50c. per ton less in each instance.

Mr. Banks talked the terms over with Dale L. Pitt, manager of the Premier mine, and together they agreed to add to the original offer, terms of $1 per ton on all ore exceeding 200,000 tons, subject to endorsement by Mr. Guess. Before this suggestion reached Mr. Guess, Mr. Banks had returned to Vancouver, where he found instructions from his London office to sink a shaft on B. C. Silver territory near to the corner of Premier's Simpson claim, so he wrote to Mr. Guess, informing him of this, and stated that under the circumstances it was not worth while proceeding with the question of the Premier company mining and treating B. C. Silver's ore.

In February, 1928, at an extraordinary general meeting of B. C. Silver Mines, Premier voted its shares against increasing the capital of B. C. Silver Mines to $2,500,000 by the creation of 1,000,000 shares at $1 par, and defeated the motion. Premier so voted because it considered it a waste of money to sink the shaft and to incur other major expenditures when it had offered B. C. Silver the facilities of its shaft and large and efficient plant on a basis, in Premier's opinion, at lower per ton cost than B. C. Silver could handle the ores even if it had the plant.

Mr. Banks then wrote to Mr. Guess to ask if Premier would sell its interest in B. C. Silver, and in reply Premier gave an option until July 1, 1928, on its 562,824 shares in B. C. Silver to Selukwe Mining & Finance Company for $500,000. Premier was asked for a four-month extension of this option, and refused, but stated that if in four months' time Seluwke came forward with the cash, it was highly probable that Premier would sell. There has been no communication between Premier and B. C. Silver or Seluwke since.

U.V.X. Will Resume Work at Sudbury Claims

UNITED VERDE Extension Mining is preparing to resume its exploratory drilling campaign, suspended since last winter, on the Mount Nickel property, in the Sudbury district of Ontario, Canada. The Mount Nickel property is one of the oldest dormant nickel-copper prospects remaining in the Sudbury area. It was bought by the Great Lakes Company in 1899 and opened up by means of a shaft to a depth of 165 ft. and some drifting at the 75 level. Early attempts to operate were failures, but later a considerable tonnage of ore was raised by leasers and disposed of to the Mond Nickel Company at Coniston.

Diamond drilling in more recent years has disclosed ore, said to amount to 60,000 tons averaging 3½ per cent combined metals, nickel predominating. The property is on the same norite-sedimentary contact in which the Creighton and other famous contact deposits have been found, and in an effort to prove copper enrichment of its ore at depth, a diamond drilling camgaign was instituted last fall by United Verde Extension, of Arizona, which now holds an option on the property. Four holes were put down. To supplement the results of this drilling another deep hole will be put down further to explore the contact area north of the known ore deposit.

Howe Sound Buys Holden

Purchase of Holden copper mine, near Lake Chelan, Washington, by Howe Sound from Lake Chelan Copper is reported. The property is 87 miles north of Wenatchee, on the Great Northern Railroad. This property was located 30 years ago, and about $200,000 has already been spent in developing it.

Extend Fisk Ophir Tunnel

Fisk Ophir Mining has driven its tunnel a distance of 1,660 ft. in its property at Ophir, Utah, and a contract has been let to drive the tunnel another 100 ft. to the Green Monster fissure. Since work was begun Nov. 1, last year, more than 10 ft. a day has been averaged in this work.

Seawell Hydraulic Mining Bill Finally Vetoed

THE Seawell Hydraulic Mining Bill, under consideration by the California Legislature, developed a nimbleness that was the despair of its opponents. Defeated in the Assembly, it was brought back and passed by a vote of 42 to 30 on May 9. It was then sent to the Senate Finance Committee instead of to the Committee on Mines and Mining, as is customary. On May 13 the Senate Finance Committee, by a vote of 8 to 6, tabled it. James D. Stewart, hydraulic mining operator, addressed the committee in favor of the bill. W. T. Ellis opposed it. Apparently all was over. However, the Senate by a vote of 23 to 16 ordered the bill up for vote before the Senate, and on May 14 approved it by a vote of 21 to 18. On May 15 Governor Young vetoed the hydraulic mining bill, and this action was sustained by the Assembly. The bill provides for the investigation and purchase of dam sites for the erection of débris-restraining dams.

Utah "Platinum" Mine to Be Investigated

INFORMATION concerning the stock-selling tactics of Koyle Mining, of Salem, Utah, widely known as the Dream mine, has been laid before the prosecuting attorneys of the third and fourth judicial districts of Utah to ascertain as to whether a judicial investigation should be asked. Officials of the Dream mine recently reported that a drift had been driven for several months through a black formation. Finally, the management had a sample taken and found that the ore carried 3 or 4 per cent platinum, according to the story printed in several Salt Lake papers. On the strength of this report, the price of the stock jumped to several dollars a share.

Hundreds of people are said to have gone to the mine to view the fabulous discovery. Among these were state and government investigators. Among those who were particularly active in buying the stock were fellow members of John H. Koyle in the Mormon Church. Koyle, the founder of the enterprise, reported that in his wanderings through the mountains he saw an angel, who promised to give him guidance so that he might unearth great treasure. Stories of frequent heavenly revelations were helpful in financing the driving of a tunnel in which the alleged phenomenal platinum discovery was made.

Cutting Loses Mine Suit

Efforts of H. C. Cutting to regain title to the Independence property, in Siskiyou County, Calif., have proved futile, as the Supreme Court of the United States refused to review the lower court decision awarding ownership to M. P. Bryan and his associates.

Emergency Shipment of Large Pump Prevents Flooding of Mine

THE industrial achievement of shipping a large pump 28 hours after receipt of order and thereby preventing a mine from being flooded, justly leads *The Worthington News,* of the Worthington Pump & Machinery Corporation, to conclude that romance is found in modern big business. Details of the achievement, as recounted by that publication, follow:

"About 2 p. m., April 9, a telegram was received from Calumet & Arizona Mining stating that its mine at Valedon, N. M., was being flooded at the rate of 400 g.p.m. On the afternoon of April 5, while shooting a face on the 1,600 level, this flow of water broke through, drowned the two Worthington pumps situated there, and filled the mine to the 1,500 level. Not only did this halt all operations at the mine, but complete destruction of the property was threatened by the flow of water.

"The Holyoke works [of the corporation] was immediately asked to furnish a 6x18 in. horizontal duplex forged fluid end pump capable of pumping 420 g.p.m. against a total head of 1,500 ft.—this pump to be installed on the 1,350 level before the water reached that point. All other work was temporarily halted and concentrated on this special request. Although a pump of the desired size, but designed for oil line service, was in stock, it was necessary to make several changes so that the pump could be lowered into the mine.

"Work on the pump was continued uninterruptedly from the time the order was received until the afternoon of April 10, when the work was completed. Inasmuch as every day meant a loss of thousands of dollars to the Calumet & Arizona company, authorization was given the Holyoke works to ship the pump by express. The fact that it cost nearly $3,200 more to ship by this means instead of by fast freight gives an idea of the urgency of the order. The Boston & Maine Railroad furnished an end-opening baggage car, the pump was loaded and, at 5 p. m. April 10, was on its way to Schenectady, N. Y., where the motor and starter for the pump were added to the shipment by the General Electric Company.

"The pump left Schenectady on April 11 and reached its New Mexico destination—traveling by the fastest passenger trains—on the afternoon of April 14. Gearing for the pump was shipped on April 15, an erector reached the mine on the 19th, and the pump went into service on the 22d—in ample time to save the mine."

Statement on New Refinery Made by American Metal

AMERICAN METAL has issued a statement outlining its connection with the new custom copper refinery being built at Copper Cliff, Ont., at the request of the Sudbury correspondent of *E.&M.J.* The official information on the relative extent to which the various interests involved in the Ontario Refining Company will participate in the new enterprise confirms the reports appearing in these columns three weeks ago. The statement follows:

"American Metal, through its subsidiary, U. S. Metals Refining, at Chrome, N. J., which has an annual capacity for refining 500,000,000 lb. of copper, holds a long-term contract with International Nickel for the refining of its blister production. When it became apparent that this production would increase largely, making it necessary to provide additional refining capacity, it was decided to build a refinery jointly in Canada, and to offer participation in this plant to Consolidated Mining & Smelting, which will no doubt control some of the blister copper that will come to the new plant. The American Metal Company and the International Nickel Company will have an interest of 80 per cent and the Consolidated Mining & Smelting Company an interest of 20 per cent in the new company.

"Because of our experience with copper-refining plants, the details of the construction and operation will be left largely in our hands. An agreement has been reached with Fraser-Brace Engineering Company to handle the construction. C. H. Aldrich, the manager of the Chrome copper refinery, will supervise the construction and will have charge of the operations. The contemplated capacity of the plant is 20,000,000 lb. per month, and the plant will be so constructed as to permit this capacity to be doubled. It is estimated that approximately 600 men will be employed in the operation, and they will be almost entirely Canadian labor. In order that the plant may function smoothly from the beginning of operations, certain key men acquainted with this type of work will be brought up from United States. It is also contemplated that several men will be brought from Canada to the Chrome plant, where they will familiarize themselves with electrolytic copper refining, preparatory to occupying positions with the Canadian refinery."

Toronto Letter

By Our Special Correspondent for Northern Ontario

Important Changes Made in the Personnel of Ontario Department of Mines

TORONTO, May 18, 1929.—Charles McCrea, Minister of Mines for Ontario, has announced important changes in the department. T. W. Gibson, Deputy Minister of Mines, has been made advisory consultant, and T. F. Sutherland, Chief Inspector, has been promoted to the position of Acting Deputy Minister. Mr. Gibson is one of the oldest public servants in Ontario, having been appointed private secretary to the Commissioner of Crown Lands in 1880. When the Bureau of Mines was established in 1891, Mr. Gibson became secretary and in 1900 he succeeded the late Archibald Blue as its director. At that time the Bureau was still a part of the Department of Crown Lands. The growing importance of mining in Ontario led the government to appoint a Deputy Minister to the Bureau, which position Mr. Gibson took over in 1906. In 1923, the Mining Bureau was separated from the Department of Lands and Forests and was created as a separate department by itself, with Mr. Gibson as Deputy Minister, in which position he has continued since that time. Mr Gibson's reputation for ability and sound judgment has always earned for him the respect and confidence of the entire mining fraternity, not only in Ontario but throughout the whole of the Dominion. His reputation extends beyond the boundaries of the country itself, and his work over a period of so many years is to a very large extent responsible for the building up of an efficient department and the establishment of excellent mining laws.

T. F. SUTHERLAND joined the Mines Branch in 1911, and after two years as district inspector in northern Ontario was appointed Chief Inspector. He graduated from Queen's University as a mining engineer in 1903 and until his appointment as inspector followed his profession, chiefly in the West.

Howey Gold Mines, of Red Lake, is now placing orders for mill equipment. The grinding and crushing department will be designed for a capacity of 1,000 tons a day, and the mill itself will be built as a unit for 500 tons. The Hydro-Electric Power Commission expects to have power available next February and the mill is expected to be ready by that time. The material and equipment for the mill will be transported by water in 30-ton barges, with marine railways over a few short portages.

Developments at the Newbec property, in the Rouyn district, have reached an interesting stage, and on the 125 level, high-grade copper ore has been found over a width of 25 ft. The ore is in two sections cut by a diabase dike, and these geological conditions are similar to those at the Noranda. On the north side of the dike there is 7½ ft. of ore and on the south side 17½ ft. On the 250 level a crosscut is being driven vertically under this discovery and should reach its objective in a few days.

Mount Isa Railroad Opened Last Month

ACCORDING to dispatches from Brisbane, J. Mullan, Attorney General of Queensland, Australia, formally opened the Duchess-Mount Isa railroad early in April. This line connects the silver-lead-zinc mines at Mount Isa with the port of Townsville. On the occasion of the opening C. J. Gray, manager at the mines, spoke on the possibilities of these properties and congratulated the Queensland government on completion of the line. F. W. Draper, chief engineer of Russo-Asiatic, which controls Mount Isa, also spoke.

Design 500-Ton Mill for Lake St. George Mine

National Mining Corporation, a British holding company, which also owns the Lake St. George property, in New South Wales, is designing a 500-ton plant for this property, which carries silver-lead-zinc ore. A small 35-ton pilot plant has been installed. In the meanwhile, efforts are being made to induce the Australian government to build a 26-mile railroad from the mine to Bungendore, the nearest railroad station. Proved and probable reserves at this property have been estimated at more than 1,500,000 tons, averaging 7 per cent lead and 13 per cent zinc.

Wiluna Intends to Start Mill in June, 1930

Operation of the new 1,250-ton mill being constructed at the Wiluna Gold property, in Western Australia, should start some time in 1930, probably about June. A. H. Collier, vice-chairman of the board of directors of the company, recently visited the property. While in Melbourne he stated that about 1,000,000 tons of ore have been proved above the 300 level. Recently an orebody 28 ft. wide was struck on the 500 level of the mine.

Utah Cuts Wages 25c.

Wages of Utah Copper, at Bingham, Utah, were reduced on May 16, 25c. a day to conform with the lower price for copper. Wages are now $1 higher than last September, when the price of copper started to climb.

San Francisco Section Discusses Mine Taxation

AT the meeting of the San Francisco section of the A.I.M.E., May 14, W. E. Colby addressed the members on the subject of mine taxation. He pointed out the fact that the miner contends with the idea that ore in a mine is a gift from the gods and that a mine is thereby a favorable target for taxation. In early Western mining, before organized government was developed, the miner escaped taxation, but afterward mining claims were first taxed as personal property and then as real property. When title passes to a corporation, the number and variety of taxes increase, as the corporation seems to be the subject of every form of taxation. In their eagerness to tax, legislators have encountered difficulties. In California a state income tax upon mines, following the federal income tax law, has been recently passed in an effort to surmount some of these difficulties.

Mr. Colby called attention to the seriousness of the subject by stating that so close is the margin between success and failure that this question of taxation may throw the balance to the adverse side and some mines may be taxed out of existence. He instanced the case of the gold miner and stated that there is a real and logical reason why the gold miner should be exempted from some of these taxes, particularly the income tax. "The power to tax carries with it the power to destroy," quoted Mr. Colby, who said in closing: "If you mining men are not vigilant some of your properties will be destroyed."

Granville S. Borden, the second speaker, discussed the federal income tax and its provisions relating to depletion, discovery-depletion, and revaluation details. He explained some of the difficulties involved in valuation for income tax purposes.

Minnesota School of Mines Students on Field Trips

STUDENTS of the School of Mines and Metallurgy of the University of Minnesota, Minneapolis, are making their annual field trips. The sophomore class is at Crosby, Minn., on the Cuyana Iron Range, where the students are making a survey of both an underground and an open-pit mine. In July they will move to Ely and Tower for a geological study of the Vermilion Range.

The junior geologists are in the Black Hills region of South Dakota, where they spend six weeks studying mines and geological formations. Junior mining and metallurgical students will study mining and metallurgical practice at various places on a Western trip that will include Colorado Springs, Cripple Creek, and Denver, Colo.; Rock Springs, Wyo.; Salt Lake City, Garfield, Bingham, Park City, and Eureka, Utah; and Los Angeles and San Francisco, Calif.

Utah Copper's 1928 Earnings Exceeded 1927 by $10,300,000

UTAH COPPER COMPANY reports net income of $24,876,246, after depreciation but before depletion, for the year ended Dec. 31, 1928. This compares with net income of $14,587,032 in 1927, $13,807,310 in 1926, and $11,103,504 in 1925.

Statement of Operation for 1928

Operating revenue:		
Copper produced		$41,400,365
Gold produced		2,085,842
Silver produced		533,397
		$44,019,605
Operating expenses:		
Mining, including stripping charge	$5,343,735	
Ore delivery, mine to mill	1,448,607	
Milling	6,109,765	
Treatment, freight and refining	6,342,166	
Selling expense	342,279	19,586,554
Profit from operations		$24,433,051
Miscellaneous income, net		4,167,314
Total income		28,600,365
Charges against income:		
Depreciation	$1,217,092	
Plant and equipment retirements	138,982	
Federal income tax and other charges	2,368,044	3,724,119
Net income to surplus account		$24,876,246

In his remarks accompanying the report D. C. Jackling, president of the company, states that the results of the company's operations for the year afford a striking illustration of constantly increasing benefits arising from the policy and practice of maintaining facilities, appliances, and methods on the highest plane of adaptability and efficiency attainable. Electrification of operations at the mine is proving even more advantageous than expected as a prime factor in cost reduction and operating flexibility in that department. Less notable innovations in other departments continue their contributions, small individually, but impressive in the aggregate, toward constantly decreasing costs, as clearly evidenced in comparing the records of successive years. The readiness with which operations of the property as a whole can adapt themselves to changing conditions, economic and otherwise, is shown by their tonnage and production performance in meeting increasing market demands for copper. Copper output for the first quarter of 1928 was 55,604,174 lb. and 3,442,000 tons, whereas for the last quarter of the year the figures were 85,911,474 lb. and 5,414,300 tons, a composite increase of over 55 per cent, accomplished without any addition to operating facilities and with only nominal expansion of working forces. Operating equipment is now being adjusted toward a better balance as between departments, especially at the mills. This will be completed in the first half of the current year, after which the effectual, all-around capacity of the property will be 60,000 tons per day, in company with high metallurgical efficiency and corresponding to an annual copper production of around four hundred million pounds, dependent upon the grade of ore, which must always vary somewhat from year to year.

Operations at the Mine

Three churn-drill holes were completed during the year, and active work was continued on three others, the aggregate depth drilled amounting to 5,101 ft. This work is being done in the northerly and westerly portions of the property. Improvements in operating methods and metallurgy and consequent reductions in costs during recent years have made it possible to add to the ore reserves, heretofore recorded, ore of a lower copper content, and some drilling has been done in order to determine the extent of such lower, but under existing conditions profitable, grade ores underlying the deposit as previously developed. Total ore reserves as of Dec. 31, 1928, amount, as they will be mined, to approximately 625,000,000 tons, averaging 1.066 per cent copper. To date there has been mined 176,144,651 tons. The sum of the ore removed and the reserves remaining indicate that, without any consideration of what future development may disclose, there will be mined eventually over 800,000,000 tons. The yardage of capping, converted into terms of tons, together with the ore mined and shipped to the reduction plants at Garfield, corresponds to a total quantity of material mined of 31,864,335 tons; equivalent to an average of 88,023 tons per operating day.

Utah Copper Production Data

	1928	1927
Copper, lb.	273,823,351	233,002,661
Silver, oz.	917,226	795,888
Gold, oz.	104,292	89,303

As in recent years, and as will be the case in the next few years, mining operations were most active on upper levels of the orebody where the grade of ore is below average. It is necessary to continue operations in this way in order to control the slopes of open pits and establish and maintain conditions best adapted to safety and economy in the removal of the lower- and higher-grade parts of the orebody. This necessity is emphasized in consideration of the fact that the elevation of the uppermost mining operations is 1,700 ft. above the present base level of shovel pits, and that eventually it will be necessary to mine ore at least 1,000 ft. below the floor of the existing excavation. A total of 16,558,500 dry tons of ore was mined and shipped to the mills. Underground operations in the limestones in the southwestern part of the property have progressed in a very satisfactory manner, and during the year 46,512 dry tons of copper and lead ores were shipped from this source. Recent developments have indicated a very considerable tonnage of this class of ore.

Surplus From Operations

Balance–Dec. 31, 1927		$56,073,667
Less net adjustment of property accounts and depreciation reserves to conform to tax determinations		435,672
		$55,637,995
Net income for year		24,876,246
		$80,514,241
Less additional income taxes for prior years	$344,865	
Dividends paid	12,995,920	13,340,785
Balance of surplus–Dec. 31, 1928		$67,173,456

In the last annual report mention was made of the fact that the capping removed since inception of operations and deposited on surface adjoining the mine had oxidized to a point where meteoric waters were dissolving a very appreciable amount of copper. These percolating waters average about 15 lb. of copper per thousand gallons. There was leached in this way during the year, and deposited in improvised precipitating plants, 1,933,235 lb. of copper at a cost of 6.2c. per pound. Profiting by this experience, a large central precipitating plant has been erected at a point low enough to receive all such waters carrying copper in solution that are not tributary to the smaller plants. In connection with this it is interesting to realize that the large yardage of capping, formerly rejected as worthless, now promises a copper production of approximately one billion pounds—assuming a 70 per cent recovery as probable.

Mining costs reflected the improvements made in recent years largely by the gradual replacement of steam shovels and locomotives with electric equipment. The cost for the year, including a proper apportionment of fixed and general charges, but exclusive of federal taxes and depreciation, was 31.78c. per ton, compared with 37.34c.

per ton for the previous year. The direct mining cost was 15.59c. per ton of ore, compared with 18c. for 1927. Of this cost, 11.73c. represents the actual mine charges and the balance, 3.86c., overhead expense. All stripping costs, together with a proper apportionment of prepaid expense charges, were absorbed in mining costs during the year, these items amounting to 16.19c. per ton of ore mined.

Improvements during the year reflected in the main a continuance toward completely supplanting steam power by electric energy. As a result, eleven 85-ton electric locomotives were substituted for a like number of steam locomotives, and during the coming year all steam locomotives will be so replaced. To furnish power for this haulage system, four 1,000-kw. rotary converters with necessary transformers and switching apparatus were installed. A new compressor building was completed, with air compressors having a total capacity of 11,000 cu.ft. per minute.

Milling Operations

The quantity of ore treated at the concentrating mills at Garfield was 16,558,500 dry tons, about equally divided between the Arthur and Magna plants. This total is equivalent to 45,742 tons per operating day. The average copper content was 0.992 per cent, or 19.84 lb. per ton, as compared with 0.979 per cent and 19.58 lb., respectively, for 1927. Average recovery in the form of concentrates was 85.56 per cent, or 16.97 lb. per ton, compared with 89.12 per cent and 17.45 lb., respectively, for 1927.

When the market demand for copper increased sharply it became profitable to sacrifice some mill recovery in the interest of larger metal output. The mills had an efficient capacity of 45,000 to 50,000 tons per day in company with recoveries of copper up to 90 per cent, both tonnage and recovery factors depending somewhat on the character and grade of ore. It was found economically advantageous in the last quarter of the year to increase to about 60,000 tons per day, which resulted in lower mill recoveries because the fine-grinding equipment was inadequate to reduce so large a tonnage to proper fineness for subsequent treatment. Average milling cost for the year was 36.9c. per ton, compared with 45.23c. for 1927—a reduction of 8.33c. per ton.

Concentrates shipped to the smelter contained 281,077,725 lb. of copper, the average grade being 31.53 per cent, compared with 240,944,666 lb. and 25.10 per cent, respectively, for the year 1927. Precipitates derived from mine and waste dump waters contained 1,976,851 lb. of copper. After deducting smelting and refining losses, the net production of refined copper for 1928 was 273,823,351 lb.

The average cost per net pound of copper, including depreciation of plant and equipment and all fixed and general expenses (except federal taxes), and after crediting gold, silver, and miscellaneous earnings, was 6.38c. compared with 7.54c. for the preceding year, computed on the same basis. The value of the gold and silver recovered and the miscellaneous earnings amounted to 1.22c. per pound of copper, as compared with 1.16c. for 1927. Per-ton operating costs on concentrating ore, including all fixed, general, and maintenance charges (except federal taxes), are shown below, by periods, from 1910 to 1928, inclusive:

Years	Tonnage	Mining	Ore Delivery	Milling	Total
1910-1916	47,814,225	$0.3308	$0.2841	$0.3824	$0.9973
1917-1923	52,550,951	0.4506	0.2361	0.8661	1.5528
1924-1926	52,356,500	0.3460	0.1093	0.5153	0.9706
1927	13,811,500	0.3734	0.0926	0.4523	0.9183
1928	16,558,500	0.3178	0.0874	0.3690	0.7742

Mining Company Dividends Total New High in May

DIVIDEND DISBURSEMENTS by American mining companies totaled $29,830,215 for May, 1929. This constitutes a new record for the month of May as well as for the entire list of mid-quarter months, as shown in the accompanying tabulation of payments in the last one and one-half years:

	1928	1929
February	$17,797,953	$21,678,018
May	17,359,998	29,830,215
August	19,866,615	.....
November	19,247,397	.....
Average	$18,567,944	$25,754,117

Larger dividends distributed by the copper companies are primarily responsible for the large increase in the May total. Anaconda contributed the greatest increment, with an increase from $0.75 to $1.75 in its quantity rate per share, which was paid on nearly twice as many shares, altogether adding approximately $7,000,000 to this month's total, compared with that for May, 1928. Other copper companies to report increased dividend payments over a year ago are Miami, U. V. X., Cerro de Pasco, Andes, and Granby Consolidated. A. S. & R.'s dividend is larger also. Likewise, Bethlehem Steel's resumption of dividends on its common stock is a fairly important item in this month's total. New Quincy Mining, Utah silver-lead producer, reports an initial payment aggregating $140,000; and Teck-Hughes reports a $0.15 per share payment that was not matched in May, 1928.

Lessened payments were made by Freeport Texas Sulphur, Hollinger Consolidated Gold, and Lucky Tiger-Combination. New Cornelia is absent, of course, as earnings of this property will henceforth be reflected in dividends paid by the consolidated Calumet & Arizona Mining Company. California Rand and Wright-Hargreaves, precious-metal producers, are the only actual absentees on this month's list.

E.&M.J. Compilation of Mining Dividends and Yields for May, 1929

Companies in the United States	Situation	Per Share	Total	Per Cent Annual Yield
American Smelting & Refining	Various	$1.00 Q	$1,829,940	3.8
Anaconda Copper, c, z, l, s	Various	1.75 Q	9,211,258	3.9j
Bethlehem Steel	Various	1.00 R	1,800,000	3.7
Bunker Hill & Sullivan, l, s	Idaho	0.75 MX	245,250	6.3
Colorado Fuel & Iron, pfd	Various	2.00 Q	40,000	6.0
Freeport Texas, su	Texas	1.00 Q	729,844	10.7j
Homestake Mining, g	S. D.	0.50 M	125,580	9.2j
Miami Copper	Ariz.	1.00 Q	747,115	5.3
National Lead, pfd. "B" l	Various	1.50 Q	375,000	5.1
New Jersey Zinc	Various	2.00 Q	981,632	3.6j
New Quincy Mining, s, z	Utah	0.10 I	140,000	....
U. S. Steel, pfd	Various	1.75 Q	6,305,497	4.9
United Verde Extension, c	Ariz.	1.00 Q	1,050,000	15.6j
Vanadium Corporation	Various	0.75 Q	283,775	4.4j
Companies in other countries				
Amparo Mining, g, s	Mexico	0.01 Q	20,000	....
Andes Copper Mining	Chile	0.75 K	2,320,352	2.8j
Cerro de Pasco, c, s	Peru	1.50 Q	1,684,263	5.2j
Granby Consolidated, c	B. C.	1.75 Q	786,386	6.4j
Hollinger Consolidated Gold	Canada	0.05 FW	246,000	9.7
International Nickel of Canada, pfd	Canada	1.75 Q	158,959	5.8
Lucky Tiger-Combination, g, s	Mexico	0.05 M	35,789	13.6j
Teck-Hughes, g	Canada	0.15 Q	713,574	8.2j
Total			$29,830,215	

c, copper; z, zinc; l, lead; s, silver; g, gold; n, nickel; su, sulphur; Q, quarterly, I, initial; K, irregular; M, monthly, MX, 25c. monthly and 50c. extra; j, based on dividends for the last 12 months.

Shenandoah-Dives Syndicate has been incorporated in Colorado with a capitalization of $3,500,000. The incorporators are R. W. Gordon, R. M. Webster, and L. H. Drath. This company owns properties in the Silverton district, where it is now erecting the first unit of a 600-ton mill.

Pend Oreille Lead & Zinc Company, at its extraordinary general meeting held at Spokane on April 30, ratified the proposal to reorganize the company under the name of Pend Oreille Mines & Metals Company, as outlined in *Engineering and Mining Journal* for April 20. 1929. J. Jansen, secretary, informed the meeting that already shareholders had applied for more stock than they were entitled to under their rights. L. P. Larsen, president of the company, stated that holders of preferred stock may turn in their stock payment for new rights.

London Financial News

By W. A. Doman,
Special London Correspondent

London, May 7, 1929—Financing of N'Changa Copper Mines, in Northern Rhodesia, has begun in earnest. Some weeks ago I mentioned that the following nine companies had become interested in N'Changa as the result of the withdrawal of the offer of the American Smelting & Refining Company: British South Africa Company, British Metal Corporation, Johannesburg Consolidated Investment Company, Rhodesian Anglo-American, Rio Tinto Company, Messrs. N. M. Rothschild & Sons, Union Corporation, Anglo Metal Company, and Minerals Separation. The agreement that has been made is subject to approval of the shareholders at a meeting to be held on Monday next. N'Changa will increase its capital to £1,000,000 by the creation of 400,000 new ordinary shares of £1 each. Rhodesian Congo Border Concession will take up 100,000 shares at £3 each, and N'Changa will offer to its shareholders 200,000 shares at the same price, and in the event of the N'Changa acquiring additional areas, it will allot to the Rhodesian Congo Border an additional 100,000 shares. Minerals Separation, Ltd., cease to be general managers, and Sir Edmund Davis, D. O. Malcolm, G. W. Gray, L. A. Pollak, C. E. Temperley, and F. E. Marshall will join the board.

Big things are now expected of the Kansanshi mine, owned by Rhodesia Katanga company. That efforts have been made to obtain control is clear from the following cablegram sent to T. D. Boyne, manager at Elisabethville for Sir Robert Williams & Company: "All offers to purchase Kansanshi mine by Americans or other groups have been declined. Tanganyika Concessions group have bought out Chartered Company's holdings in the Rhodesia-Katanga Junction Railway & Mineral Company. They have no intention of parting with the control of the company." As the Chartered Company is credited with having held 200,000 shares, the Tanganyika group has by far the majority holding. There are few free shares, and I understand a market is to be made in Brussels.

Platinum companies in South Africa seem to be falling upon lean times. Development results at Onverwacht have been disappointing, and during the first quarter of the year only a few isolated ore deposits have been disclosed. Some other companies also are not proving too successful. In the Chemical & Metallurgical report just issued it is stated with regard to platinum that a semi-commercial plant for the recovery of platinum and other metals from complex South African concentrates was installed last year, and has been in operation for some months. Giving consideration to the scale of the operations, working costs, and recoveries, the company's processes have indicated a solution to the problem of the commercial exploitation of the South African platinum deposits. The directors are, however, not prepared to incur the heavy additional capital expenditure necessary for the enlargement of the plant pending close consideration, jointly with the South African producers, of the general policy to be adopted in the handling of these concentrates and their economic future.

Tanganyika Goldfields, Ltd., announces the discovery in Tanganyika territory of alluvial tin. The wash has been traced for "over one mile in length —narrow but rich, some pits over 100 lb. per cubic yard."

Tarapaca & Tocopilla Nitrate Company has entered into a provisional agreement with the Grace Nitrate Company to acquire that company's property, known as Oficina "Paposo," effective Jan. 1, 1929, for 977,000 fully paid 10s. shares. The Tarapaca capital will be raised from £400,000 to £1,000,000. Alianza Nitrate, after two blank years, is paying a 7 per cent dividend.

Rio Tinto Copper Production Declined in 1928

Rio Tinto Company, Ltd., reports the maintenance of steady operating conditions at its mines in Spain. In the first half of 1928 copper production fell off rather badly. This was not due to any one cause, but was the result of a number of factors. The company struck an almost barren area, which was worked through before the year ended. There is no reason to suppose that this year's copper production will not be fully up to average; in fact, Sir Auckland Geddes, chairman of the board, stated that he would be disappointed if the company does not make up the tonnage that it lost last year. The average copper content of the company's massive pyrites is tending to fall slowly, the copper content of the porphyritic ores is holding up well, and when the new concentrator is at work, the company hopes to be able to more than meet the diminution in copper production from the massive pyrites. Export of ore continues satisfactory, and prospects in this department are good. Equipment of the mines and railways is well maintained.

The distribution of the company's ores from Norway, Portugal and other countries is proceeding smoothly and without any features or difficulties deserving comment. Rio Tinto's Welsh plant, at Port Talbot, is running well, and has had a satisfactory year. The work of Pyrites Company, Ltd., is progressing most satisfactorily. Its works at Wilmington, Del., are running smoothly and well. It paid a 10 per cent dividend this year, and may increase its capital to £500,000 from the present £300,000. This will enable it to pay off an advance of £200,000 made to enable completion of its new zinc plant. The Pyrites Company is not, of course, confined to the United States of America, and its importance in other spheres is steadily increasing.

European Pyrites Corporation, which Rio Tinto owns jointly with the Metallgesellschaft, is continuing the work of European ore distribution satisfactorily. The new metallurgical works, in Belgium, of the Société Anonyme Belge d'agglomeration des Minerais are nearing completion.

Rio Tinto has acquired considerable interests in Northern Rhodesia, indirectly through Minerals Separation, Ltd., in which it has become the largest shareholder. A half-year's dividend of 2s. 6d. per share on the preference shares, and a final dividend of 25s. per share on the ordinary shares, has been declared, payable May 1, 1929.

Copper Trading Started on National Metal Exchange

Trading in copper futures was initiated on the National Metal Exchange, in New York City, on May 15. The addition of this metal is expected to broaden trading operations on the exchange.

The opening copper call is at 10 a.m. daily, and trading ceases at 2:50 p.m. Trading hours on tin futures will continue 10:15 a.m. to 3 p.m. as heretofore.

The copper contract is for 50,000 lb., which at current price levels gives it a money value of $9,000. At present, ten positions will be traded, with July the first month and the nine succeeding months. Beginning in July twelve months will be traded in. Fluctuations will be in hundredths of a cent, with a maximum of 200 points (2c.) for any one day above or below the previous day's close in each position.

Contract grades of copper are prime electrolytic and prime Lake copper, assaying 99.90 per cent in ingots and/or bars and/or wire bars of standard weights and sizes. Discount grades will be best selected copper, assaying 99.80 per cent, casting copper 99.50 per cent, and casting copper assaying 99.00 per cent in ingots and/or ingot bars. In addition, the rules include as discount grades rough or blister copper in six grades, 94 to 98 per cent inclusive.

Prime electrolytic copper is deemed the contract grade, the seller having the option of delivering prime Lake copper at the contract price. The seller also has the option of delivering any one of the other grades above named at specified discounts from the contract price. Prime electrolytic copper, Lake, best selected, and casting copper shall be deliverable from licensed warehouse, but any of the officially listed brands may be delivered from the producing refinery or smelting plant, provided, however, that such smelting plant or refinery is located in New York, New Jersey, Maryland, Missouri, or Pennsylvania. All other tenderable grades shall be delivered only from licensed warehouse. Suitable freight differential is provided where delivery is made from refinery or smelter.

Minimum commission for buying or selling is $10 per contract for exchange members residing in the United States or Canada, and double this rate for non-members.

St. John del Rey Earnings Show Large Increase in 1928

EARNINGS of St. John del Rey Mining Company, operating the Morro Velho mine, in Brazil, totaled £87,934 in 1928, compared with £68,586 in 1927.

Profit-and-Loss Account for 1928

Income

Gold, twelve months to Dec. 31, 1928	£416,501	
Silver, twelve months to Dec. 31, 1928	2,589	
	£419,090	
Government duties and transport charges	6,380	£412,710

Expenditures

Working cost in Brazil	£296,727	
Development	17,224	
London expenses	10,825	324,776
Operating profit		£87,934
Amount brought forward from last account		41,061
		£128,995
Interim dividends	£19,907	
Proposed final dividends	47,220	
Balance of income tax	575	67,702
		£61,293
Transfer to capital works account	£20,000	
Balance carried forward	41,293	£61,293

The tonnage crushed shows an increase of 4,200 tons as compared with that of the preceding year, and the yield per ton is higher by 2s. 7½d. There was a decrease of 1s. 3½d. a ton in working cost, but a larger amount was spent on development in the mine. Some deficiency of labor was experienced during the latter part of the year, owing to an unusually large number of men leaving the mine to plant crops because of the high price of maize.

In April a lode was reached at horizon "25," which, owing to its position, was presumed to be the main lode, but was found on being developed to a considerable length to differ in characteristics from the main lode and to be of inferior quality, though large in size. Explorations were accordingly carried out, which resulted in the discovery of another orebody to the north of that previously encountered. This orebody has now been laid open for a length of 350 ft., and is described as resembling the main lode both in appearance and value. Exploration southeast of the "22" horizon intersected an orebody giving some 300 ft. stoping length, with an average width of 6 to 7 ft. The ore is described as of high-grade over the whole area laid open. A valuable addition to the reserves of ore has thus been obtained. A considerable amount of work on the Espirito Santo and other lodes has been carried out, but concerning these there is nothing of special importance to report. Owing to the delay which has taken place in proving the main lode at horizon "25," the directors have postponed coming to a decision as to the construction of the direct route which, as explained in former reports, is necessary if the mine is to be worked to greater depth. Their decision, however, will be made when further information has been received as to the development of the mine at the lowest horizon, and when the directors have considered the report on the mine which they are obtaining from Prof. L. C. Graton. In view of the importance of the questions to be decided as to the future working of the mine, the board will give shareholders the opportunity of expressing their opinion upon the policy to be adopted.

During the last ten years, ventilation in the mine has at no time been as good as it is now, and this is entirely attributable to the advanced condition of the mainway, the opening of the emergency exit, and the introduction of new stoping methods. There is no exaggeration in saying that present ventilation conditions at horizon "25" are more comfortable than those which existed for years at horizon "22."

During the year trials were made in the mine with a special rock drill, recently obtained from the United States, and considered suitable for exploration purposes in the vicinity of the main lode up to distances of some 200 ft. Unfortunately, enormous rock pressures, the nature of the country rock, and the fact that the Morro Velho air pressures are lower than is usual elsewhere, have rendered this machine quite unworkable. Indeed, rock pressures, combined with the weak nature of the slates or schists, would in all probability effectively prevent the successful use of any convenient form of boring appliance for purposes of exploration, for it is no uncommon thing for ordinary holes bored for blasting in development drivings to be closed by pressure. These conditions have increased the difficulties of mining. A mechanical shovel was also tried for the purpose of accelerating development driving, but again the low Morro Velho air pressures militated against its successful employment.

During the year temperatures, both air and rock, remained fairly steady, excepting that at the two lower horizons a drop has taken place in both air and rock temperatures, owing to the increase in the main ventilating current. The situation in respect to ore reserves remains practically as it was last year, the total on Dec. 31, 1928, being 1,021,537 tons.

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TENNESSEE COPPER & CHEMICAL COMPANY reports net profit of $1,813,624 for 1928, compared with $408,498 in 1927 and $1,089,617 in 1926. The company's production of copper in 1928 was 13,585,853 lb. and of iron sinter 69,265 tons. Production of sulphuric acid was the largest in the company's history, and a satisfactory tonnage of fertilizer was sold from both Northern and Southern plants. The company's Burra Burra and Eureka mines were operated throughout the year, with a small decrease in mining costs. Ore reserves on Jan. 1, 1929, were estimated at 5,597,580, a slight decrease from the 5,683,165 tons reported on Jan. 1, 1928. The flotation plant daily capacity was increased to 900 tons.

Canadian Government Adopts New Share Tax

THE Minister of Finance for the Dominion government has moved an amendment to the resolution in the budget with regard to the tax on the sale of shares. The original proposal was to tax all shares selling at under $3 at the rate of one cent a share. In taxing low-priced mining shares this might mean an assessment amounting to 10 per cent, or in some instances more, and it was felt that such a tax would make the raising of money for mining purposes very difficult. Under the amendment the tax will be one-tenth of a cent for every share of stock sold at a price of 50c. or less; one-quarter of a cent for every share of stock sold or transferred at a price of between 50c. and $1; one cent for every share of stock sold or transferred at a price between $1 to $3 per share; two cents a share on shares selling between $3 and $20; three cents a share on shares selling between $20 and $100; and four cents a share for stock selling over $100 a share. The amendment becomes effective July 1, 1929.

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HARKER GOLD MINES, LTD., shareholders have ratified the proposal of the directors to purchase 250,000 shares of Greene-Stabell, in the Rouyn area of Quebec, at 40c. a share, with an option for six months on a similar block for the same price. Before the option is exercised a special shareholders' meeting will be called, when progress reports of both properties will be submitted and discussed.

MOSS MINES financial statement showed liquid assets of $70.000 and current liabilities of $7,000 at Dec. 31, 1928. There remains to be paid on property purchase account the sum of $75,000, which it is proposed to take care of by the sale of additional shares, of which 1,320,000 remain in the treasury. During the greater part of the year work was confined to the sinking of a new vertical shaft to a depth of 400 ft., together with 783 ft. of drifting and crosscutting on three levels. On the 125 level two oreshoots have been opened up which average $15 per ton across a 30-in. face. On the 375 level the oreshoot has been opened up for only 28 ft., but for this distance it averages $20 per ton across a 56-in. face.

PATRICIA DENT GOLD MINES, LTD., shareholders have given formal ratification of the purchase of the property, consisting of eighteen claims at Clearwater Lake in Patricia district, Ontario, and other assets of the Patricia Lake Shore Mining Syndicate. Directors of the company have also agreed to dispose of 200,000 shares of treasury stock to private interests to finance initial development. An engineer is being sent to the property to prepare plans for a diamond-drill campaign this summer. Surface stripping and trenching have already disclosed two veins.

The Market Report

Metal Markets Continue to Mark Time

New York, May 22, 1929—Business in the non-ferrous metal markets continues exceedingly quiet. In its general aspects, the situation is unchanged from that prevailing during the greater part of the last two months; quotations remain virtually unchanged. Among the minor metals antimony is slightly easier, and the tension on the market for tungsten concentrates has relaxed somewhat.

Copper Unchanged

Sales of copper continue to be made by the custom smelters at 18c. delivered, Connecticutt Valley basis, and the volume of business is about the same as that reported each week since the market break early in April. Primary producers, generally speaking, continue out of the market, though they report a gradual accumulation of inquiries for special shapes and brands that cannot be absorbed by the custom smelter.

Foreign business continues desultory at a small percentage of normal. The delay in settlement of the reparations question is closely linked with the lack of interest by foreign buyers. Producing interests, in general, are inclined to feel that considerable June copper will be bought for foreign account as soon as the reparations question is definitely settled and that such buying will stimulate commitments by domestic fabricators. Copper Exporters, Inc., maintains its price at 18.30c., c.i.f. usual European destinations.

Yesterday's announcement of the Kennecott-Chase Brass Company merger is construed by some factors as a bullish item, the contention being advanced that this further step in the integration of the copper industry will tend to stabilize the market and smooth off the peaks and troughs of buying movements. Curtailment of production has become quite prevalent since the Anaconda announcement, as a number of the larger producers have announced decisions to take similar action.

Little Change in Lead

With the exception of the withdrawal of some of the cheaper offerings of chemical lead in the Middle West, there is no change in the lead situation from that which existed last week. The volume of sales has been a little greater, but the large consumers have, almost without exception, remained out of the market, with the result that although sellers have taken a fair quantity of orders, most of them have been for carloads, and in many instances 20-ton carloads at that. Three-quarters of the inquiry has been for prompt shipment, with most of the remainder for June, and it is generally conceded that consumers have yet to provide themselves with most of their June requirements. This means that heavier buying may be expected very soon.

In the East the price remains at 7c., New York, the American Smelting & Refining Company's contract price since April 15. The offerings made by a small producer through a broker last week at 6.65c., St. Louis, were all absorbed by last Wednesday, when the price was advanced to 6.70c. Since then 6.75c. has been done by others, though one seller reports inability to obtain more than 6.70c. One of the leading producers continues to quote 6.80c. on all business not booked at the average price, but his sales have been small. Today the market is somewhat firmer than a week ago, with the nearer approach to an expected improvement in sales.

Daily Prices of Metals

May	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
16	17.775	44.00	7.00	6.70	6.60@6.65
17	17.775	43.75	7.00	6.70@6.75	6.60@6.65
18	17.775	43.875	7.00	6.70@6.75	6.60@6.65
20	17.775	44.00	7.00	6.70@6.75	6.60@6.65
21	17.775	43.75	7.00	6.75	6.55@6.65
22	17.775	43.75	7.00	6.75	6.60
	17.775	43.854	7.000	6.729	6.617

Average prices for calendar week ending May 18, 1929, are: Copper, 17.775; Straits tin, 44.021; N. Y. lead, 7.000; St. Louis lead, 6.704; zinc, 6.625; and silver, 54.146.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; that is delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary form of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

May	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
16	74	72 3/4	83	198 1/4	201	23 3/4	23 5/8	26 11/16	26 9/16
17	76 1/4	73 7/8	83 5/8	196 1/2	199 5/8	23 13/16	23 3/4	26 13/16	26 9/16
20	Holiday	...	...	....	.....	.....	.....	....	.....
21	75 1/8	73	83 5/8	196	198 7/8	23 3/4	23 5/8	26 13/16	26 9/16
22	74	72 3/4	84	196 3/4	199 1/4	23 11/16	23 9/16	26 13/16	26 9/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

May	Sterling Exchange "Checks"	Silver		Gold London	May	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
16	4.84 5/8	54 1/8	25 3/16	84s11 1/2d	20	4.84 1/2	53 3/4	Holiday	.....
17	4.84 9/16	54	25 1/8	84s11 1/2d	21	4.84 1/2	53 7/8	25 1/8	84s11 1/2d
18	4.84 1/2	53 5/8	25	.....	22	4.84 1/2	53 7/8	25 1/16	84s11 3/8d

Average: Silver, 53.875c.; Sterling Exchange, 484.531c.

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Zinc Unchanged

Virtually the same situation prevails in zinc as has been reported in the three or four weeks immediately preceding. The week's tonnage is somewhat larger, though the range of prices reported continues to be from 6.55 to 6.80c. per pound. A slightly larger tonnage was reported at the higher end of the range this week, but the tonnage sold at 6.55c. was even greater, proportionally. One seller is offering freely at the latter quotation, another at 6.65c., and most of the producers continue to hold for 6.75@6.80c. per pound. High-grade shipments continue large. The nominal high-grade quotation is 8c. per pound.

Tin Holds Close to 44c.

Neither dealers nor consumers took much interest in tin this week, and the price varied within a narrow range, from 44 down to 43¾c. today for prompt Straits. Forward shipment has been about ⅛c. higher, and 99 per cent Chinese tin, of which a fair amount is available, is about 1c. lower than Straits. Banca commands about the same price as Straits. The supporting group in London continues to buy occasionally around £200.

Silver Still Lower

The steady decline in silver prices has continued during the past week, the quotation on May 18th, of 53⅝c., being the lowest since June 5, 1927. Unsettled conditions in China, resulting in lower exchange rates, have been the cause of a weak tendency, although it is reported that moderate orders have been received from India. The closing is uncertain.

CORRECTION.—We are advised by Handy & Harman that their quotation on London bar silver for May 15, appearing in *Engineering and Mining Journal* of May 18, was incorrectly transmitted and published at 25¼d. per ounce. The correct quotation for that date was 25⅛d.

Mexican dollars (Old Mexican pesos): May 16th, 40¾c.; 17th, 40⅝c.; 18th, 40⅜c.; 20th, 40½c.; 21st and 22d, 40⅝c.

Mark at Year's High

The German mark advanced close to par yesterday. Closing cable quotations of the principal foreign exchanges on Tuesday, May 21, were as follows: Francs, 3.90¼c.; lire, 5.235c.; and marks, 23.81¾c. Canadian dollars, 41/64 per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c.

ANTIMONY—Per lb., duty paid. New York: Chinese brands, 8⅛c. per lb. for all positions. Cookson's "C" grade, spot, 14¾c.

BISMUTH—Per lb., New York, in ton lots, $1.70. Smaller lots, $1.85 and up.

CADMIUM—Per lb., New York: 80@95c. Active demand.

IRIDIUM—Per oz., $230@$240 for 98@99 per cent sponge and powder.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 35c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM—Per oz., $38@$40. Small lots bring up to $50. Nominal.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, $68 per oz. Transactions between dealers and refiners in the outside market are commonly reported at several dollars less.

QUICKSILVER—Per 76-lb. flask. $121. Small lots command the usual premiums.

Prices of Chromium, Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Titanium, Tungsten, Vanadium, and Zirconium are unchanged from the issue of May 4.

Metallic Ores

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Wolframite, $16.25@$16.50; Western scheelite, $16.50. Nominal.

Antimony, Chrome, Iron, Manganese, Tantalum, Titanium, Vanadium, and Zircon ores are unchanged from quotations in the May 4 issue.

News of Consolidations Features Tri-State Market

Joplin, Mo., May 18, 1929

Blende	Per Ton
High	$46.30
Premium blende, basis 60 per cent zinc	$44.00@ 45.00
Prime Western, basis 60 per cent zinc	43.00@ 44.00
Table concentrates, 60 per cent zinc	41.00@ 43.00
Flotation concentrates, 60 per cent zinc	39.00@ 41.00
Average settling price, all zinc concentrates	44.14
Galena	
High	$92.60
Basis 80 per cent lead	90.00
Average settling price, all lead concentrates	91.20

Shipments for the week: Blende, 10,930; lead, 1,790 tons. Value all concentrates the week, $645,680.

Producers are unable to output more than 13,000 tons of zinc concentrates per week, and buyers are resuming large purchases and heavier shipments, precluding the accumulation of an overly large reserve stock.

The Woolf-Gaines purchase of the Falcon smelter at Fort Smith, Ark., is a part of a consolidation of this property with numerous producing mines that will output sufficient ore and concentrate to supply the smelter's demand. Rumor of a lease of the Kusa smelter to the American Metal Company refuses to be quieted, yet no admissions are granted. Labor shortage is partly responsible for the restricted output in the Tri-State district.

Platteville, Wis., May 18, 1929

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$46.75
Lead Ore	
Lead, basis 80 per cent	$90.00

Shipments for the week: Blende, 631 tons; lead, 120 tons. Shipments for the year: Blende, 13,447; lead, 760 tons. Shipments for the week to separating plants, 1,375 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, and Tripoli are unchanged from prices in the May 4 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic) Per lb., 4c. Market firm.

Antimony Oxide, Calcium Molybdate, Sodium Sulphate (Salt Cake), Sodium Nitrate, and Zinc Oxide are unchanged from prices in the May 4 issue.

Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or duty paid, port of entry, $105. Spiegeleisen, 19@21 per cent, $33@$34 f.o.b. furnace.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.35@$1.50 f.o.b. works. Market strong.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferrovanadium, Nickel Silver, and Yellow (Muntz) Metal are unchanged from prices in the May 4 issue.

Rolled Metals

Copper, Lead, Zinc, Monel Metal, and Nickel Sheets are unchanged from prices in the May 4 issue.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of May 4.

Iron, Steel and Coke

IRON—Per gross ton, Valley furnaces, Bessemer, $19; basic, $18.50; No. 2 foundry, $18.50.

STEEL—Base prices per gross ton Pittsburgh, billets and slabs, $35@$36; plates, structural shapes, and soft steel bars, per 100 lb., $1.95.

COKE—Per gross ton, Connellsville furnace, $2.75@$2.85. Connellsville foundry, $3.75@$4.85. Byproduct coke, Ohio and Kentucky (Connellsville basis) $6.50; Buffalo and Detroit, $8.50@$9.

Mining Stocks—Week Ended May 18, 1929

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	135¼	121	126	Mr.29,My.20 Q	1.75
Anaconda Cop., new	New York	113⅜	101¼	106½		
Andes Copper	New York	53½	48⅝	51⅜	Mr.29, My.6 Q	0.75
Arizona Com	Boston	3½	3½	3½	Ja. 16, Ja. 31 S.A.	0.25
Calumet & Ariz	New York	134½	126⅝	129	My.31, Je.17 Q	2.50
Calumet & Hecla	Boston	44½	40⅞	42½	My.31, Je.29 Q	1.00
Cerro de Pasco	New York	100⅛	97⅜	97½	Ap.11, My. 1 Q	1.50
Chile Copper	New York	98⅛	98¼	98¼	Je. 1, Je.28 Q	0.87½
Con. Coppermines	N. Y. Curb	12⅜	11½	11⅝		
Copper Range	Boston	24½	22	22½	Mr.15, Ap.15 Q	0.50
East Butte	Boston	3⅜	3¼	3⅜	Dec., 1919	0.50
Granby Con	New York	82	71	74½	Ap.12, My.1 Q	1.75
Greene Cananea	New York	156	146½	148	Mr. 7, Ap. 1 Q	2.00
Howe Sound	New York	68⅜	62½	64½	Mr. 30, Ap. 15 Q	1.00
Hudson Bay	N. Y. Curb	18⅛	17⅜	17⅞		
Inspiration	New York	48⅛	40⅜	43⅜	Mr.14, Ap. 1 Q	1.00
Isle Royale	Boston	24½	20	21½	My. 31, Je.29	0.50
Kennecott	New York	90	84	87⅝	No. 30, Ja. 2 Q	2.00
Magma Copper	New York	71⅜	68⅛	71⅛	Mr.30, Ap.16 Q	1.25
Mason Valley	N. Y. Curb	1¼	1¼	1¼		
Miami Copper	New York	42⅛	37⅜	39¼	My1, My15 Q	1.00
Mohawk	Boston	59⅛	55	56½	Ap. 30, Je. 1 Q	1.50
Mother Lode	New York	4	3⅜	3⅜	De.14, De.31 SA	0.20
Nevada Con	New York	49¼	45	46⅜	Mr.15, Mr.30 Q	0.75
New Cornelia	N. Y. Curb	...	...	47½	Fe. 1, Fe. 18 Q	0.50
Noranda	N. Y. Curb	57½	53½	56		
Ohio Copper	N. Y. Curb	2½	1⅝	2	Sept., 1926	0.03
Old Dominion	Boston	11⅛	9½	10⅛	Dec., 1918	1.00
Phelps Dodge, new	N. Y. Curb	...	...	79¼		
Quincy	Boston	37½	32	33½	March, 1920	1.00
Roan Antelope	N. Y. Curb	45½	43	43		
St. Mary's M. L.	Boston	34	31⅜	32½	Fe.25, Mr.12	2.00
Seneca Copper	New York	6½	5½	5⅝		
Shattuck Denn	N. Y. Curb	18⅞	16½	17⅞		
Sherritt-Gordon	Toronto	8.15	7.80	7.85		
Tenn. C. & C.	New York	19½	18½	18½	My.31, Je.15 Q	0.25
United Verde Ex	N. Y. Curb	17¼	17¼	17¼	Ap. 4, My. 1 Q	1.00
Utah Copper	New York	...	...	325	Mr. 15, Mr. 30 Q	3.00
Waite-Ack.-Mont	Toronto	4.20	3.75	4.20		
Walker Mining	Salt Lake	4.07½	3.90	3.97½		
Wenden Copper	N. Y. Curb	1¼	1⅛	1⅛		
LEAD, ZINC, SILVER						
Ahumada Lead	New York	2⅜	2⅛	2⅜		
Amer. Z. L. & S.	New York	36½	33½	33½	May, 1917	1.00
A. Z. L. & S., pfd.	New York	99	99	99	Nov. 1920	1.50
Bingham Mines	Boston	62	60	60	Mr.15, Ap.5	0.50
Bunker Hill & S.	N. Y. Curb	...	...	143	Ap.25, My.6 X	0.75
Butte Cop. & Zn.	New York	6⅛	5⅛	5⅛		
Butte Cop. Con.	Boston Curb	*55	*50	*51		
Butte & Sup.	New York	7⅛	7	7	Mr. 15, Mr. 30 Q	0.50
Callahan Zn-Ld.	New York	2⅛	2	2⅛	Dec., 1920	0.50
Chief Consol.	Salt Lake	3.45	3.25	3 42½	Fe. 1, 1928 K	0.10
Consol. Ld. & Zn. "A"	St. Louis	16½	15⅛	15½	Ap.5, Ap.10	0.25
Constitution	Spokane	*33	*30	*33		
Dayrock	Spokane	2.50	2.45	2.45	Mr.23, Mr.30	0.03
Dickens Consol	Spokane	*6½	*5⅜	*6		
Eagle-Picher	Cincinnati	18	17	17⅛	Mr.31, Ap.15 Q	0.20
Eagle-Pich., pfd.	Cincinnati	102	102	102	Jan. 15 Q	1.50
Erupcion	Boston Curb	...	...	*10	Ja. 1, 1928 Q	0.07½
Eureka Bullion	Salt Lake	1.02½	*97	1.00		
Eureka Lilly	Salt Lake	.....	.....	1.42½		
Eureka Standard	Salt Lake	...	...	5.00		
Evans-Wallower	N. Y. Curb	20⅜	15⅜	19		
Evans-Wal., pfd.	N. Y. Curb	...	...	84½	Mr.20, Ap.1 Q	1.75
Federal M. & S.	New York	235	235	235	Je., 1927	10.00
Fed. M. & S., pfd.	New York	100	100	100	My.24, Je.15 Q	1.75
Gladstone	Spokane	*12	*11⅛	*12		
Golconda	Spokane	1.66	1.40	1.57	Mr.20, Ap.1 Q	0.02
Grandview	Spokane	*45	*41	*42½		
Hecla Mining	N. Y. Curb	18⅛	18⅛	18¼	My.15, Je.15 Q	0.25
Highland-Surprise	Spokane	*17½	*12	*15		
Jack Waite	Spokane	*10½	*10½	*10½		
Kootenay Florence	Spokane	*14½	*13	*14		
Lucky Jim	Spokane	*12½	*12	*12½		
Lucky Tiger-C.	Kansas City	†5.25	†4.75	....	De.4, De.20 MX	0.12
Mexican Premier	Spokane	1.89	1.80	1.89		
National Lead	New York	145	142	145	Je. 14, Je. 29 Q	1.25
Natl. Lead, pfd. A	New York	140½	140	140½	Mr. 1, Mr. 15 Q	1.75
Natl. Lead, pfd. B	New York	118	118	118	Jy. 19, Au 1 Q	1.50
N. J. Zinc, new	N. Y. Curb	83½	79⅜	83½		
New Quincy	Salt Lake	2.40	1.95	2.40	My.15, My.27 Q	0.10
Noble Five	Spokane	*58	*50	*55		
North Lily	Salt Lake	8.50	8.25	8.25	Jan. 20 Q	0.25
Park Bingham	Salt Lake	8.00	7.50	7.75		
Park Utah	New York	9⅜	7	9	Mr. 19, Ap. 10 Q	0.20
Pend Oreille	Spokane	6.00	5.00	5.60		
Rico Argentine	Salt Lake	*35	*33	*35	No. 30, De. 15 Q	0.03
Ruth-Hope	Spokane	*32	*25	*32		
St. Joseph Lead	New York	74½	63	71½	Ju. 8, Ju.20 QX	0.75
Sherman Lead	Spokane	*37½	*36	*36½		
Silver King Coa	Salt Lake	13.75	13.25	13.72	Mr. 20, Ap. 1 Q,	0.25
Silversmith	Spokane	*16	*15½	*15½	Oct., 1926 Q	0.02
Sunshine Mining	Spokane	2.20	2.00	2.17½	De. 20, BM	0.02
Tamarack-Custer	Spokane	*60	*49½	*49½	Sept., 1924	0.25
Tintic Standard	Salt Lake	14	14	14	De. 23, Ja. 23 X	0.20
Tonopah Belmont	N. Y. Curb	...	...	*62½	Oct., 1925	0.05
Treadwell-Yukon	Toronto	12.50	12.00	12.00		
United Zinc Smg	N. Y. Curb	1⅛	1	1⅛		
Utah Apex	Boston	4⅛	4	4	May 15, June 1	0.25
Utah Met. & Tun	Boston	1⅛	1	1	Dec., 1917	0.30
Whitewater	Spokane	*75	*70	*75		
Yellow Pine	Los Angeles	....	....	*16	Dec., 1925 QX	0.04
GOLD						
Alaska Juneau	New York	6⅛	5⅜	5⅞		
Barry-Hollinger	Toronto	*31	*28	*29		
Central Manitoba	Toronto	*49	*45	*45		
Coniaurum	Toronto	...	...	*45		
Cresson Consol.	N. Y. Curb	*81⅛	*68⅛	*75	Mr.30, Ap.10 Q	0.02
Dome Mines	New York	10	9⅛	9⅛	Mr.30, Ap..20 Q	0.25
Golden Cycle	Col. Springs	†1.90	†1.85	....	Fe.15, Mr.1	0.04
Gold Hill	Toronto	*5	*3	*3⅛		
Hollinger	Toronto	6.90	5.90	6.00	My.3, My.20 M	0.05
Homestake	New York	76⅛	75¾	76⅛	My.20, My.25 M	0.50
Kirkland Lake	Toronto.	1.08	1.00	1.00		
Lake Shore	Toronto	26.50	25.40	25.75	Je.1, Je.15 Q	0.20
McIntyre-Porc	New York	17	17	17	My.1, Je.1 Q	0.25
Portland	Colo.Springs	†*15	†*11	....	April, 1927	0.02
Rand Mines	New York	35⅜	35⅜	35⅜	Fe. 21,'28 Am.Sh.	1.52
Siscoe	Toronto	*77	*69	*77		
Sylvanite	Toronto	1.55	1.50	1.50		
Teck-Hughes	Toronto	9.20	8.90	8.90	Ap. 7,My 1, O	0.15
Tom Reed	Los Angeles	*30	*15	*15	Dec., 1926	0.02
Unity Gold	N. Y. Curb	1⅞	1⅛	1⅛		
Vipond Consol	Toronto	1.06	1.00	1.00	April, 1927	0.03
Wright-Hargreaves	Toronto	1.67	1.45	1.60	Oc. 16, No. 1	0.02½
Yukon-Alaska	N. Y. Curb	....	....	35⅛		
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	18⅜	16½	18⅜		
Castle-Trethewey	Toronto	*36	*32	*34		
Consol. Cortes	N. Y. Curb	...	...	*18⅜		
Dolores Esperanza	N. Y. Curb	1⅜	1⅛	1⅛	July, 1923	0.05
Keeley	Toronto	*52	*50	*50	Mr.15, 1928	0.04
Mining Corp.	Toronto	4.50	4.30	4.36	My 30, Je.13	0.12½
Montana-Idaho	Spokane	*13	*11½	*12		
N. Y. & Hond. Ros	N. Y. Curb	...	...	18	Ap.17,Ap.27 QX	0.05
Nipissing	N. Y. Curb	3½	2⅜	2⅜	Mr.30,Ap.20 Q	0.07½
Premier Gold	N. Y. Curb	2⅜	1⅞	1⅞	Mr.14, Ap.4	0.06
Tonopah Exten	N. Y. Curb	....	....	*10	April, 1925	0.05
Tonopah Mining	N. Y. Curb	....	....	3⅜	Ap. 7, Ap. 20	0.07½
United Eastern	N. Y. Curb	....	....	*50		
Yukon Gold	N. Y. Curb	*68⅜	*68⅜	*68⅜	June, 1918	0.02
IRON AND STEEL						
Bethlehem Steel	New York	108½	104½	105⅜	Jl.19, Au.15 Q	1.00
Beth. Steel, pfd, 7%	New York	119⅜	118½	118½	Je.1, Jl.1 Q	1.75
Cleveland-Cliffs	Cleveland	240	220	235	Ap.15, Sp.25 Q	1.00
Colo. Fuel & Iron	New York	67½	63	66⅜		
Colo. F. & I., 1st pfd.	New York	78	77	78	My.10,My 25 Q	2.00
Great Northern Iron	New York	29	28	28½	Dec.15, K	2.00
Inland Steel	New York	90	85⅜	89	My.15, Jn. 1, Q	0.87½
Republic I. & S.	New York	96⅜	91½	94	My. 11, Je. 1, Q	1.00
Republic I. & S., pfd.	New York	...	...	111	Je.12, Jl. 1, Q	1.75
Sloss-Sheffield S. & I.	New York	105½	104½	104½	Mr. 11, Mr.20, Q	1.50
Sloss-Sheff. S. & I., pfd.	New York	108	108	108	Mr.20, Ap.1, Q	1.75
U. S. Steel	New York	179⅜	174	174⅜		
U. S. Steel, pfd.	New York	142⅜	142½	142½	My. 4,My 29, Q	1.75
U. S. Steel, new	New York	180⅜	175	176½		
Virginia I. C. & C.	New York	25½	25½	25½	Jan., 1924	1.50
Virginia I.C.& C., pfd.	New York	47	47	47	Jl.16, 1928 SA	2.50
MISCELLANEOUS						
Aluminum Co. of Am.	N. Y. Curb	289	265	285		
Alum.Co.of Amer., pf.	N. Y. Curb	107½	107½	107½	Mr.15, Ap.1, Q	1.50
American Metal	New York	58¼	52	58¼	My.9, Je. 1 Q	0.75
Amer. Metal, pfd., 6%	New York	117⅛	117⅛	117⅛	My.21, Je.1, Q	1.50
Amer. Sm. & Ref.	New York	104	99	100⅜	Ap.12, My.14 Q	1.00
Amer. & Sm. Ref., pfd.	New York	136	136	136	My. 3, Ju. 1 Q	1.75
Ang. Ch. Nitrate	N. Y. Curb	42⅛	38⅛	42		
Asbestos Corp.	Montreal	12⅛	12	12⅛	Jan. 1926	1.50
Asbestos Corp., pfd.	Montreal	49	39	46⅛	De. 31, Ja. 15 Q	1.75
Consol. M. & S.	Montreal	415	400	410	De.31,Ja.15,SA	6.25
De Beers Consol.	New York	...	...	23	Ja. 19, Ja.26,	0.48
Federated Metals	N. Y. Curb	33	32	32	Mr.27, Ap.5 Q	0.75
Freeport Texas	New York	46½	44½	45	Ap. 5, My. 1 Q	1.00
Int. Nickel Can.	New York	53¼	48¾	51¼	Je.1, Je.29 Q	0.20
Int. Nickel, pfd.	New York	...	...	121	Ap.2,My.1 No.1 Q	1.75
Newmont	N. Y. Curb	211	201½	206	Mr.30, Ap.15 Q	1.00
Patiño M. & E.	New York	41⅞	39½	40⅜	My. 31, Jn. 28	4s
So. America G. & P.	N. Y. Curb	2⅜	2¼	2¼		
Texas Gulf Sulphur	New York	79½	76½	77	Je.1, Je.15 Q	1.00
U. S. Sm. R. & M.	New York	61⅛	58⅜	59⅜	Ap. 4, Ap. 15 Q	0.87½
U. S. Sm. R. & M., pfd.	New York	53⅜	53⅜	53⅜	Ap. 4, Ap. 15 Q	0.87½
Vanadium Corp.	New York	94⅜	98⅛	91⅛	Fe.1, Fe. 15 Q	0.75

Toronto Standard Stock Exchange, Toronto, courtesy Arthur E. Moysey & Co.; Salt Lake Stock Exchange, courtesy J. A. Hogle & Co. and Logan & Bryan, New York; Standard Stock Exchange, Spokane, courtesy Pohlman Investment Company.

*Cents per share. †Bid or asked. Q, Quarterly. A. Annually. SA, Semi-annually. M, Monthly. BM, Bimonthly. FW, Four weeks. K, Irregular. I, Initial. R, Resumprion. X, Extra. The first data given is that of the closing of the books: the second that of the payment of the dividend.

LONDON QUOTATIONS—WEEK ENDED MAY 7, 1929

	High	Low	Last	Date	Amount
Alaska Mexican ($5)	20/—	20/—	20/—		
Alaska Treadwell (25)	67/6	66/10½	67/3	Nov., 1926	4 p.c.(d)
Aramayo Mines (25 frs.)	63/9	60/7½	61/3	May 1929	5 p.c.(†)
Burma Corp (10 rupees)	17/1½	16/7½	17/—	Feb., 1929	7 annas*
Bwana M'Kubwa (5s)	18/6	16/6	17/10½		
Camp Bird (2s)	2/6	2/3	2/6	April, 1928	16⅔ p.c.
El Oro (£1)	4/9	4/4½	4/6	Nov., 1924	2½ p.c.*
Frontino & Bolivia (£)	9/—	9/—	9/—	Jan., 1929	3½ p.c.
International Nickel of Canada (Quoted in dollars with a fixed rate of $5 to the £1) (no par value)	$56½	$49⅞	$54½	Mar., 1929	20(c)
Mexican Corpn. (£1)	14/9	14/1½	14/6		
Mexican Mines of El Oro (£1)	4/6	3/9	4/6	Dec., 1926	3½ p.c.*
Mount Isa (£)	46/9	46/3	46/3—		
N'Changa Copper Mining. (£1)	75/—	69/4½	70/—		
Oroville Dredging (4s)	2/—	2/—	2/—	Nov., 1928	31½ p.c.
Rhodesian Congo Border (£1)	117/6	103/9	117/6		
St. John del Rey (£1)	17/6	16/—	17/—	Apr., 1929	7½ p.c.
San Francisco Mines (10s)	36/3	34/7½	36/3	Jan., 1929	25 p.c.
Santa Gertrudis (£1)	12/—	10/4½	12/—	Jan, 1929	7½ p.c.
Selukwe (2s. 6d.)	6/6	6/5	5/9	April, 1917	6¼ p.c.
S. Amer. Copper (2s.)	2/9	2/4½	2/4½	Nov. 1917	75 p.c.
Tanganyika (£1)	63/3	58/9	61/10½	July, 1928	5 p.c.
Union Miniere de Haut-Katanga (Brussels)	11,985.	11,350	11,985	April, 1929	300.00 fr.

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian frs. and free of taxation. (d) U. S. Dollars.